NATURE

Vol. 143 SATURDAY, MAY 27, 1939 No. 3630

CONTENTS

	PAGE
Research in Civil Defence	869
Zoological Miscellany. By Dr. Karl Jordan, F.R.S.	871
Progress in Seismology. By Dr. R. Stoneley	872
Structure and Existence in Mathematics. By Countess von Zeppelin	873
Engineering Facts and Figures	874
Expanding Horizons. By J. N. L. B.	875
Fission of Heavy Nuclei: a New Type of Nuclear Disintegration. By Dr. N. Feather	877
The Concept of Instinct. By Dr. J. A. Loeser	880
The Aurora Polaris and the Light of the Night Sky	884
Obituary Notices:	
Sir Robert Bolam, O.B.E. By Prof. R. B. Green	885
Sir William Butler, Bart. By Prof. R. H. Hopkins	886
Mr. G. E. Blundell. By F. J. N.	886
News and Views	887
Letters to the Editor:	
Reflection of Atmospherics from the Ionosphere.—Prof. B. F. J. Schonland, O.B.E., F.R.S., J. S. Elder, J. W. van Wyk and G. A. Cruickshank	893
Disintegration of Nitrogen by Fast Neutrons.—E. Baldinger and Dr. P. Huber	894
Crystal Structure of Glucosamine Hydrobromide.—Dr. E. G. Cox and G. A. Jeffrey	894
Absorption Spectra of Proteins.—Ensor Holiday	895
Protein Stability as Revealed by Ultracentrifugal Analysis.—Dr. Harold P. Lundgren	896
X-Rays and the Cyclol Hypothesis.—Prof. J. D. Bernal, F.R.S., I. Fankuchen and D. Riley	897
Rapid Calculation of Relative Humidity from Readings of the Sling Hygrometer.—Dr. A. J. Turner	897
Rapid Graphical Analysis of Circuit Performance by the Use of Logarithmic Charts.—D. N. Truscott	897
Structural Geology of the Bermuda Islands.—Dr. George P. Woolard and Maurice Ewing	898
Microphonic Potentials from the Utricle.—Dr. R. J. Pumphrey	898
Microspores in Diatoms.—Dr. Trygve Braarud	899
Cultivation of Rabies Virus in the Developing Chick Embryo.—I. J. Kligler and H. Bernkopf	899
Œstrous Cycle in the Cat.—Dr. H. Liche	900
Synthesis of 5 : 6-Dihydroxyflavone and the Structure of Primetin.—Wilson Baker	900
Research Items	902
International Standard of Concert Pitch. By Dr. G. W. C. Kaye, O.B.E., F.R.S.	905
Telephony in the United States	906
Jubilee of Johns Hopkins Hospital. By Walter Bett	907
Scientific and Industrial Research in Australia	907
The Dutch Congress of Natural Science and Medicine	908
University Events	909
Science News a Century Ago	909
Societies and Academies	910
Recent Scientific and Technical Books	Supp. iii

Editorial and Publishing Offices:
MACMILLAN & CO., LTD., ST. MARTIN'S STREET, LONDON, W.C.2.
Telephone Number: Whitehall 8831 Telegraphic Address: Phusis, Lesquare, London
The annual subscription rates are: £2 12 0 British Isles, £2 17 0 Foreign, payable in advance

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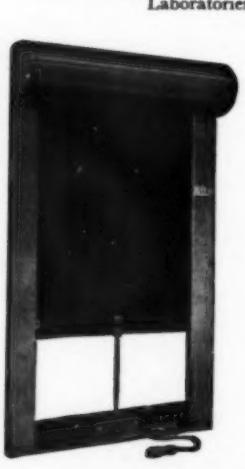

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Vol. 143 SATURDAY, MAY 27, 1939 No. 3630

Research in Civil Defence

WE are to-day faced with conditions hitherto almost unknown in history. Whereas, prior to the Great War, wars were fought between professional armies comprising a comparatively small section of the population, to-day war means that the whole community is involved in a life-and-death struggle. Air attack as a weapon used for the destruction of lives and property and as a means of undermining the morale of a nation is a very potent one, and there can be no doubt that until nations abandon aerial bombing, whatever the type of bomb used, whether it be high-explosive, incendiary or gas, it is imperative that the best resources of a country should be enlisted to reduce the effects of such enemy action and to maintain the confidence of the people in their strength and ability successfully to resist such attacks.

The organization of Great Britain for this purpose has now been in progress for some time. Much has been done to devise means for protecting the civilian population from the effects of aerial bombing, particularly by the provision of gas masks constructed on a scientific basis and later by the provision of steel shelters which will give some measure of protection against the effects of modern high-explosive bombs. Pamphlets and handbooks have been issued dealing with a variety of subjects giving the best-known means of protection from exploding bombs and gas, and for reducing the risks from fire. These publications give the latest information actually available, but the work of research goes on and there are many problems still awaiting solution. In the early days of the work of A.R.P., a considerable amount of valuable work was done by the Department of Scientific and Industrial Research. With the rapid expansion of the Air Raid Precautions Department, however, it became increasingly clear that the special problems that arose demanded the setting up of a special section of the Department to deal with them.

A few weeks ago, a new Division of the Air Raid Precautions Department of the Home Office was accordingly set up to deal specially with problems which may arise in connexion with air raid precautions, and requiring scientific research and experiment. This work is under the direction of Dr. R. E. Stradling, director of building research of the Department of Scientific and Industrial Research. But to speed up as rapidly as is desired, it is necessary to enlist every suitable and available facility for scientific research.

It is therefore to ensure, so far as practicable, that the population is given the greatest degree of protection which the skill of science can devise that Sir John Anderson has now brought into being a special Committee for Civil Defence Research. This Committee, the members of which were announced in NATURE of May 20, p. 847, is not only an advisory body. It is also intended that through it the Department will be able to make use of the resources of the universities and scientific institutions in Great Britain for the solution of problems as they arise. Facilities undoubtedly exist for conducting experiments; but it is earnestly to be hoped that they will be made freely available to assist in the extensive and intensive work now in hand. Great Britain is now alive to the risk of being unprepared to meet attack from the air, and the whole country is steadily being organized to resist the menace. Members of scientific bodies will no doubt be prepared to give their services to assist in the prevention and amelioration of suffering, and the Government is now in effect inviting all who can

to contribute to the task of research and experiment to this end. Much has already been done, but there is still much to do. The difficulties with which investigators are faced are often new, and call for fresh methods of approach. It is one matter to devise weapons of destruction, but quite a different problem to devise methods of mitigating the effects produced by that weapon or of rendering it innocuous.

This important extension of the work of the Air Raid Precautions Department will, we believe, meet with general approval. Not only is the help of scientific workers necessary to the country, but also men of science themselves have shown that they desire to help. The new Committee will meet under the chairmanship of Dr. E. V. Appleton, who is secretary of the Department of Scientific and Industrial Research. The field of investigation that lies before it is large and involves practically every branch of science—chemistry, mathematics, physics, geology, engineering and biology among many others. There is, in fact, no limit to the scope of such investigation.

The Committee, as at present constituted, consists of some leading men of science in Great Britain, but drawn exclusively from the physical and engineering sides. This would appear to be deliberate, for the immediate task of the Committee is to deal with questions arising out of the provision of shelters for the civil population, and it is believed that physical aspects will need first consideration. No doubt it will be possible to widen the basis of the inquiries undertaken in due course, by extending the membership of the Committee to cover other subjects.

The conditions under which we have lived hitherto are not intended to meet a menace such as a modern air attack. Homes suitable enough for times of peace are not constructed to withstand the shock of a modern high-explosive bomb. Some alternative protection must be provided that will withstand most of the shock that it may possibly receive. Thousands of workers employed in factories must be protected, and employers will expect advice from the Government with regard to the best means of constructing shelters for employees who are working in older types of buildings, and also to assist in the design and layout of protected quarters in new buildings. There are also questions arising in connexion with obscuring internal lighting of factories, and on the various means of giving satisfactory warnings of an approaching raid. These are only a few of the more obvious matters that in their many variations must be dealt with, and for which solutions are needed, not some day, but immediately, so that appropriate steps may be taken.

Among the problems that call for research, problems on which there is at present little or no information, are the effects of explosion on structures of different types. This involves large-scale experiments. A clear space having a radius of a mile, and with suitable subsoil, on which full-scale experiments can be conducted, is required to be put at the disposal of the Department. Such sites are very difficult to obtain in Great Britain and the failure to obtain one will inevitably handicap the work of research in this important matter; it is understood that the Department has not yet found such a site, and would welcome assistance in the matter. Research into the many problems arising in connexion with the effects of explosion, for example, transmission of shock, equivalent static pressure of blast, pressure waves produced in the ground by an explosion, and physiological effects of explosive pressures are among the matters that call for early solution. Many other problems arising in connexion with anti-gas measures, obscuration of lighting and air-raid warning suggest that the field for research is very wide.

The full weight of scientific knowledge is now being marshalled in the services of the Air Raid Precautions Department. It is a bitter comment on international affairs that scientific effort should have to be devoted specifically to this end, but, failing the effective prohibition of aerial bombing, no other course appears to be open. Indeed, the call for service is now urgent, for if Great Britain is to maintain its independence and its civilization, the country must be protected effectively and speedily from what is probably the worst form of warfare yet devised by man.

While condemning, with all reasonable men, the utter folly of war, scientific workers must recognize the dangerous qualities of the times in which we live, and will welcome the formation of the Civil Defence Research Committee. The investigations it will institute can scarcely fail to make contributions which, in the long run, will prove of value to mankind; further, its immediate task, which is directed towards the amelioration, if not the prevention, of suffering on the part of hundreds of thousands who in past years would have been respected as non-combatants, will appeal to all who are imbued with the spirit of service to humanity.

Zoological Miscellany

Festschrift zum 60 Geburtstage von Prof. Dr. Embrik Strand

Enthaltend dem Jubilar gewidmete Arbeiten ausländischer Zoologen und Palaeontologen. Vol. 1. Pp. ii + 644 + 14 plates. Vol. 2. Pp. ii + 652 + 37 plates. Vol. 3. Pp. ii + 608 + 20 plates. Vol. 4. Pp. ii + 784 + 16 plates. Vol. 5. Pp. ii + 750 + 11 plates. (Riga: Prof. Dr. Embrik Strand, Sistēmatiskās Zooloģijas Institūts, Pasta kastīte 802; London: H. E. Knowles, 1936–39.) 24*s*. 6*d*. each vol.

IT is customary in some countries, particularly in Germany, to honour a distinguished man of science on the anniversary of his sixtieth or sixty-fifth birthday by the issue of a volume containing papers written for the occasion by former pupils and other friends and admirers. In order to preserve the element of surprise for the *Jubilar*, it is understood that the matter is kept a secret. Dr. Embrik Strand, professor of zoology and director of the Systematic-Zoological Institute and of the Hydrobiological Station of the University of Lettland at Riga, evidently did not like the usual proceeding and, dispensing with secrecy, invited all and sundry to send manuscripts for a festive publication in commemoration of the anniversary of his sixtieth birthday.

The promise to publish all was most generous at the present time when scientific periodicals are overwhelmed with manuscript. The response was equally generous, the result being a *Festschrift* such as has never before been issued in honour of any zoologist. The five volumes contain 194 articles, which occupy more than 3,400 pages and are illustrated by 687 text-figures, 6 text-plates and 98 line and half-tone plates. Most articles are in German, others in English, French and Italian. The editor has extended great hospitality to some authors, one of whom contributes no fewer than fourteen articles and some others five, six or seven, which shows that there was a demand for such a publication. Although English is the language of eighteen articles, Great Britain shines rather by absence, only one article of two pages being contributed from England. The invitations were duly received, but did not create enthusiasm among British zoologists, who are unaccustomed to this kind of publicity and evidently do not like it. It is no reflection on Dr. Strand's reputation.

The articles were obviously printed more or less in the sequence in which they were received, there being no attempt at co-ordination. The absence of order presents some difficulty to the reader who is interested in a particular subject, but the editor supplies the want in volume 5, which brings a list of the articles grouped according to subject and an index to the scientific names used in volumes 1–5. Dr. Strand being an entomologist and arachnologist of world-wide reputation, it is very appropriate that most of the contributions deal with spiders and insects; but there are articles on all classes of animals from Protozoa to Mammalia and on a variety of subjects of more general import; every zoologist, inclusive of geneticists, will find a paper of some interest. Many of the authors begin their articles with an appreciation of the work of Dr. Strand, sometimes employing superlatives which must have brought a gratified smile to the stern face of the professor who frowns at the world from the frontispiece to volume 1. It is unfortunate that in Prof. Špaček's article on Dr. Strand as a lepidopterist special stress is laid on the discovery of a new subfamily of Castniidæ in Madagascar; in reality, Dr. Strand was misled by an Agaristid with the antenna more strongly clubbed than usual.

Taxonomy and purely descriptive work take up the greater part of the volumes, and many of the new forms described are named in honour of Dr. Strand. In Dr. Obenberger's article on new Buprestidæ, some fifty names are derived from Embrik and Strand singly and combined. The longest contribution (more than 400 pages) are Dr. Breuning's three articles on exotic Cerambycidæ, from various collections, inclusive of that of the British Museum. The monograph of the colliurine carabids by Herr Liebke and the survey of the Palæarctic Troginæ (Lamellicornia) by Dr. Balthasar are welcome comprehensive publications; Herr Liebke's account would have been still more helpful for future specialists if references to original descriptions had been given, as Dr. Balthasar has done; the addition would have made no appreciable difference to the length of an article occupying more than 100 pages. Both these papers are mainly concerned with the characterization of the various species and subspecies. Dr. Auber's contribution, "Die Rassen- und Artenkreise des Genus *Eos* Wagler (Aves)", stands on a very different level. The author goes deeply into systematics as a science of relationship and discusses the question of the phylogeny of the forms composing the genus, illustrating his arguments with numerous figures of the details of coloration. The account is of great value for all who study the problems of species and subspecies.

Systematists will welcome Dr. F. Poche's research on the dates of issue of Esper's "Schmetterlinge" and his supplement to Sherborn's "Index Animalium"; physiologists will be interested in Prof. O. Polimanti's observations on the sleep of domesticated and wild mammals and birds, Dr. Molitor's experimental research on the colour-sense of sphegid wasps, Prof. Monti's paper on the effect of gamma rays on the reproduction of *Cladocera*, and Dr. and Mrs. Szabo's papers on physiological and old-age deaths and on duration of life and senescence.

A contribution of a very ambitious kind is Dr. G. von Kolosváry's "Generic System of the Phenomena of Life", where the evolution of organisms is explained on the basis of endogene development. According to him, the environment has no directing influence in the origin of new species, but only stimulates a predestined development. He mentions as an example the fauna of caves, and says that the modifications in the morphology of cave species are not the result of living in caves as generally supposed, but were acquired before these organisms became cave dwellers; the species having become unfit for the conditions of a life in the open, retired into caves, where they found shelter and could go on existing. An entertaining thought, but not new. The instructive paper is not very easy to read, as the author seems to contradict himself occasionally. For example, speaking of Linneons (= species) and Jordanons (= subspecies or races) he says on p. 196 that "the Linneon splits up into races; this division does not originate new species, that is to say, the Jordanon does not develop back into a new Linneon", a mere assertion, and on p. 198 we read on the contrary " . . . the collective Linnean species (Linneons) have been divided into elementary species, so-called Jordanons . . .". If a Jordanon is a rudimentary species, it can develop into a species; in fact, many Jordanons have all the characteristics of species. Erroneous conclusions are not without merit, if they are conducive to stimulating thought and research.

The reviewer sincerely congratulates Prof. Embrik Strand on the production of a unique publication which contains much valuable information, and expresses the hope that he will continue his activities in good health for a long time.

KARL JORDAN.

Progress in Seismology

Earthquakes and other Earth Movements

By John Milne. New edition, revised and rewritten by Dr. A. W. Lee. Pp. xiv+244+24 plates. (London: Kegan Paul and Co., Ltd., 1939.) 10*s*. 6*d*. net.

SINCE the sixth edition of Milne's book in 1913—the year of his death—nothing has been published in Great Britain to take its place, although with the great development of seismology in post-War years the book has long been completely out of date. The wealth of material and its wide range make the task a formidable one, and Dr. Lee is to be congratulated warmly on the discrimination, even more than on the skill that he has shown, in completely rewriting the book. It would be quite fair to say that he has used Milne's "Earthquakes" rather as an example of the spirit in which a treatise should be written.

The specialist, as well as the general reader, will find the opening chapters of great interest. They deal with the visible results of earthquakes, and are copiously illustrated with photographs of earth fissures, fault movements and damage to buildings, bridges and water-mains. There is, too, an interesting chapter on "Earthquakes and Construction". The chapter on seismographs is extremely lucid, and the diagrams, as throughout the book, are very clear; in spite of his intimate acquaintance with several types of instrument (or perhaps because of it), Dr. Lee avoids the temptation to go into too great detail. Of great historic interest are the reproductions of the Milne seismograph records at Kew of five famous earthquakes, including the shock that wrecked San Francisco in 1906.

To give in reasonable space an account of the onsets observed in seismograms, the working up of the records of a given earthquake, and the inferences that have been drawn concerning the interior of the earth, is a forbidding task, and it is a great achievement on Dr. Lee's part that he has managed to make this section reasonably complete without overloading it in detail. There is sufficient indication of method to show how conclusions are arrived at, yet the geologist or the general reader will not be irritated at the length of description of technique. The rather diffuse topic of the distribution of earthquakes in space and time is presented with a good sense of balance, and an adequate account is given of modern work. As one would

expect, the chapter on microseisms, a subject on which Dr. Lee is the leading authority, deals fairly and informatively with a very controversial subject. The final chapter, on seismic prospecting, includes an account of recent work on the ocean floor, by which the nature of the continental shelf of the eastern coast of the United States has been made out.

The typography and general arrangement are good, and Dr. Lee has done his work so well that there are few loopholes for adverse criticism.

R. STONELEY.

Structure and Existence in Mathematics

Le Progrès de l'Esprit

Par Dr. Albert Lautman. 4 : Essai sur l'unité des sciences mathématiques dans leur développement actuel. Pp. 60. 15 francs. 5 : Essai sur les notions de structure et d'existence en mathématiques, 1 : Les schémas de structure. Pp. 82. 20 francs. 6 : Essai sur les notions de structure et d'existence en mathématiques, 2 : Les schémas de genèse. Pp. 83–160. 20 francs. (Actualités scientifiques et industrielles, 589–591.) (Paris : Hermann et Cie., 1938.)

IN the introductory volume of his work on questions of structure and existence in mathematics, M. Lautman is mainly concerned with Prof. Weyl's distinction between the two types of modern mathematical systems in which the analysis of the infinite is contrasted with the synthetic methods of algebra and group theory. He shows that this distinction need not be conceived of as a fundamental opposition between two irreducible disciplines. On the contrary, among the modern theories of analysis, it is possible to discover points of view which are characteristic of algebra and group theory. For example, the theory of equations with an infinity of variables, the arithmetical theory of algebraic functions, the theory of non-Euclidean metrics, the theory of continuous groups, the analytic theory of numbers and the theory of Pfaffian forms, all occupy an equally intermediary position between algebra and analysis. For in all these, the methods are algebraic and the results extend to analysis ; and although there is a certain analogy between contemporary physics and contemporary mathematics, in that both present a spectacle of facts which can be interpreted either by the calculus of the continuous or by that of the discrete, this duality of method, which is the principal source of the difficulties inherent in contemporary physics, is evidence of the profound unity of the mathematical sciences.

In the second volume, on structural schemes, M. Lautman maintains that with the concept of tautology, the Russell school of logicians eliminated the idea of a reality corresponding to mathematical concepts. Thus for Wittgenstein and Carnap, mathematics is nothing more than a language—or hierarchy of languages—which is quite indifferent to the content which it expresses. This, in M. Lautman's opinion, is a consequence of the deductive method which attempts to construct all mathematical concepts from a small number of primitive ideas and by means of which the qualitative nature of the theories thus constructed is lost.

In the course of three chapters on what he calls the "local" and "global" nature of mathematical theories, M. Lautman emphasizes the variety of logical relations which lie at the heart of mathematics. The solidarity of the whole and its parts, the reduction of relational to intrinsic properties and the passage from the incomplete to the absolute, are all forms of structural organization which confer upon mathematical entities a movement towards completion, by means of which their existence is established. But this existence is not solely dependent upon the fact that the structure of these entities is an imitation of the ideal structures to which they may be compared. On the contrary, it turns out that the fulfilment or complete designation of one entity gives rise at the same time to the genesis of others. It is in the logical connexions subsisting between essence and existence that these new creations are to be found.

Problems concerned with the passage from essence to existence, with examples derived from many different branches of mathematical theory in which this passage is either effected directly from the basic domain to the newly created entities—as in group transformations and algebraic functions—or indirectly by means of intermediaries which M. Lautman calls "les mixtes" and which are exemplified in Hilbertian space, occupy most of the third and final volume of M. Lautman's most interesting analytic study. Although these questions arise chiefly from the development of mathematical logic, the author takes the view that logic is only to be considered as one of the mathematical disciplines, and that the geneses manifested here are comparable with those to be observed in other mathematical

domains. Thus, M. Lautman's exposition of the metaphysics of logic is equivalent to an introduction to a general theory of connexions which unite structural and existential propositions. He calls the first period in the development of mathematical logic, dating from the early works of Russell to the year 1929, the "naive" period; and the second, dating from the meta-mathematical researches of Herbrand and Gödel, the "critical" period. It is in the investigations of the critical period that M. Lautman finds confirmation of his theory of the connexions between essence and existence—a theory which differs both from the logicism of the formalists and from intuitionist constructivism. For, from these connexions he deduces a philosophy of mathematical genesis which goes far beyond the domain of logic itself; and in this he has been immensely assisted by the work of Bernays on Hilbertian meta-mathematics.

For the rest, M. Lautman considers that the structure of experience cannot be detached from experience itself, and that reality consists in the discovery of an organizing structure in relation to matter, which is animated by its relations. He is of the opinion that in physics, as in mathematics, we are led to the Platonist conclusion that the nature of reality, its structure and the conditions of its genesis, only become knowable when we re-ascend to the ideas of which science incarnates the connexions. AMETHE VON ZEPPELIN.

Engineering Facts and Figures

(1) **Kent's Mechanical Engineers' Handbook.** Vol. 2: Design; Shop Practice. Founded by the late Dr. William Kent. Eleventh edition, rewritten by Robert Thurston Kent. (Wiley Engineering Handbook Series, Vol. 3.) Pp. xx+1378. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 25*s*. net.

(2) **The Engineer's Year-Book of Formulæ, Rules, Tables, Data and Memoranda for 1939** A Compendium of the Modern Practice of Civil, Mechanical, Electrical, Marine, Gas, Aero, Mine and Metallurgical Engineering. Originally compiled by H. R. Kempe and W. Hanneford Smith. 45th annual issue, revised under the direction of L. St. L. Pendred. Pp. lxv+xii+2824. (London: Morgan Brothers (Publishers), Ltd., 1939.) 31*s*. 6*d*. net.

(1) THE science and practice of mechanical and electrical engineering have, in recent years, developed so rapidly and to such an extent that, in the matter of the provision of suitable handbooks, the publishers of these are confronted with a problem of some complexity. Messrs. John Wiley and Sons have sponsored a number of such books in the past and, appreciating the trend of affairs, have dealt with the problem by appointing a board of editors to consider the best arrangements for future editions. They have recommended the adaptation of the handbooks which this firm publishes so as to form a co-ordinated series. The first volume deals with "Engineering Fundamentals" and contains the kind of information which an engineer associated with any branch of the profession would require to have in a readily accessible form, while the remaining four volumes of the series are devoted to the more specialized information pertaining to distinct branches of mechanical and electrical engineering. The new arrangement will be found to have brought several advantages in its train; it has permitted a more thorough and more detailed treatment of the material included in the earlier editions; it has provided a better opportunity for the inclusion of new subjects; it has eliminated a large amount of duplication of information such as could not be avoided in a number of unrelated handbooks.

The volume now under consideration is the third of the series and retains its original title, "Kent's Mechanical Engineers' Handbook". It is devoted to the two branches indicated by the subtitles "Design" and "Shop Practice", and in its preparation the advantages mentioned are much in evidence. In the first part it deals with the materials of engineering, ranging from iron and steel through all the metals and alloys used in construction to the non-metallic materials. Here are included particulars of welding as it is now applied in structures and in manufacturing processes. Corrosion-resistant metals and the methods of protecting against corrosion in different situations also find a place. The important alloys of aluminium receive appropriate treatment, and so too do those of nickel and of magnesium. In the section on non-metals, the data supplied regarding cork, rubber, asbestos, carbon and the refractories are particularly valuable as they are not, as a rule, readily obtainable.

The second part of the book is given over to the forms, proportions and other information relative to machine details and the thousand and one items which constitute the elements of shop work. Nystrom advised that "Every engineer should make his own pocket book, as he proceeds in

study and practice", but while this remains good advice, the accumulation of engineering facts and figures now far exceeds any one man's practice, and he must be largely guided by the experience of others. The importance of standardization in many details also makes such a handbook a necessary part in the equipment of the engineer. Much of the information here is of the usual nature, but especial value is attached to many items by reason of their novelty, their growing importance and their reliability, for each section has been prepared by an expert in his subject. These include such matters as control mechanisms, vibration and noise, safety equipment, dust collection, and the illumination of workshops.

The general arrangement of the book should simplify the work of reference to such a vast store of information. Despite the large number of pages, the book is of convenient size and its flexible binding enables it to remain open at any selected page.

(2) There is another side to this question of handbooks, for it may, of course, be stated with certainty that every engineer feels the need of having at hand some reliable source from which he can readily obtain information, both descriptive and quantitative, on practically all branches of his profession. For a period now of forty-five years, "Kempe's Engineer's Year-Book" has been the leading publication of this kind and also the most complete, and has become, like the slide-rule, one of those essential items that must always be within reach. Year by year it has entered upon a new edition, on each occasion being brought up to date by the excision of all that has become obsolete and the introduction of what is new and established.

The issue for 1939 is now available and once again the opportunity has been taken to incorporate new material and, where necessary, to effect the revision of tables. The information has been presented in the most concise form by experts in their several branches, and the general revision has been made under the direction of the editor of the *Engineer*. Of its two main parts, the first contains general principles and data. The second, entitled "Descriptive Sections", is devoted to practical applications of these principles in civil, mechanical, electrical, naval, automobile and aeronautical engineering works. There are also sections dealing with ancillary subjects such as acoustics, explosives, paints, depreciation, and legal notes for engineers, to name but a few of these.

The increasing revisions and additions in order to keep the book up to date with current practice have brought the 1939 volume up to 2,824 pages. It is profusely illustrated by diagrams and half-tone illustrations, and contains valuable descriptions of the products of many important engineering firms.

Expanding Horizons

Geography in the Middle Ages

By George H. T. Kimble. Pp. xi+272+20 plates. (London: Methuen and Co., Ltd., 1938.) 15*s*. net.

MR. KIMBLE has made a valuable contribution to the history of geography in this volume. His title is somewhat misleading, for the last two chapters take us beyond the strict limit of the geography of the Middle Ages and introduce the great Age of Discovery. The author shows how, for example, Fontana blended traditions of Marco Polo with knowledge gained by the Portuguese in West Africa, and laid stress on the importance of a habitable land south of the equator. This idea may have influenced Columbus—as others have pointed out—to shape his course towards the south-west rather than due west.

An important chapter deals with medieval maps. The author goes far to establish the point that many of these maps were forgeries or at least contained inaccurate information. He instances the map of Fra Mauro and the globe of Behaim, both of which were based on Portuguese material and both of which do not accurately represent Portuguese accomplishments, as evidence that the Portuguese policy of secrecy led to the falsification of material supplied to cartographers and to the general scarcity of Portuguese maps.

Two chapters deal with 'expanding horizons' in Asia and in Africa. In the latter, Mr. Kimble puts up a good case for the genuineness of the work of the anonymous fourteenth century Spanish Franciscan who seems to have had some knowledge of the west coast of Africa at least as far as Sierra Leone.

A number of well-produced photographs of early maps, and a select bibliography complete a work on which both author and publishers are to be warmly congratulated. To the latter a special word of thanks is due for encouraging the publication of works by English writers on the history of geography and thereby filling a serious gap in geographical literature. Mr. Kimble's book is worthy to stand by any of its predecessors.

J. N. L. B.

Kleine Erdbebenkunde

Von Prof. Dr. Karl Jung. (Verständliche Wissenschaft, Band 37.) Pp. v+159. (Berlin: Julius Springer, 1938.) 4.80 gold marks.

THIS admirable little book contains a large amount of information in a small space and, although succinct, is eminently readable. The nine chapters include such topics as macroseismic effects, the geography, nature and cause of earthquakes, the method of obtaining seismograms and information concerning shocks, the propagation of earthquake waves, microseisms, and the application of earthquake knowledge chiefly to seismic prospecting. Dealing with the cause of earthquakes, Prof. Jung says: "Concerning the fundamental causes of the formation of mountains, of earthquakes, and volcanicity there are only suppositions partly substantiated, and no one theory has yet found general recognition". Thereafter a nice balance is maintained between the various current theories, and an adequate discussion is given of the materials of the earth's crust and beneath the crust, which materials have sufficient strength to cause and maintain oscillations and yet yield to the forces required by isostatic theory.

The illustrations in the book are very clear and often give the results of much mathematical investigation without using a single mathematical symbol. The text is well informed and up to date. For more detailed information the student must consult the publications listed at the end of the book, which he must also do for the authors of the original works mentioned whose names are often omitted. The book is of handy pocket size and is very well printed.

E. T.

African Odyssey

By Joseph Crad. Pp. 286. (London: John Gifford, Ltd., 1939.) 12*s*. 6*d*. net.

MR. CRAD'S story of his youth and early manhood in South Africa is an "Iliad" rather than an "Odyssey"; for its main interest lies in combat of the truly heroic type. His story of life in South Africa, nearly fifty years ago, when he was pioneering in the country of the Matabele, is Homeric in its zest for battle. He took part in the Matabele War, which ended in the death and defeat of Lobengula; and then for a period was in East Africa, working in Zanzibar and making a trading journey on foot to Lake Tanganyika, when he was attacked by raiding Masai. He then travelled in other parts of the world; but of his adventures we are not told, his narrative being concerned with Africa only. In addition to service in the Boer War, he fought with the Natal forces in the suppression of the Zulu rising of 1906–7.

Mr. Crad's view of the native peoples of South Africa, notwithstanding his experience of the cruelties practised in their raids in his early days, is impartial, and for certain sides of their character he has no little admiration. In the light of his knowledge of the native he confidently anticipates that trouble, similar to that which caused the Zulu rising in 1906, is likely to recur.

The book, in view of its intimacy of detail, is a record of a phase in the relations of black and white, now completely passed away, which is of more than ephemeral interest. It is also a vivid picture of the practical working of the Matabele and Zulu military organization.

Capri

Per Immanuel Friedlaender. Tradotto da Angelo de Angelis. Pp. 168+12 plates. (Roma: Societa Italiana Arti Grafiche, 1938.) 25 lire.

ALTHOUGH Capri, the small island lying at the entrance to the Bay of Naples, has a total area of only some four square miles, it has an extensive literature. Its many interests have brought it fame since the days when it was the resort of Roman emperors. Prof. Friedlaender attempts with considerable success to survey all aspects of the island. The peculiar geological structure of the caves and caverns of the island is fully discussed, and the flora and fauna receive special notice. The second half of the book deals with the story of the people, the antiquities and the history, and concludes with a bibliography. If the volume contains little that is new, it collects much scattered matter in an accessible form. There is a map on a scale of 1 : 12,000 in an end pocket.

Practical Organic Chemistry

By Dr. Frederick George Mann and Dr. Bernard Charles Saunders. Second edition. Pp. xiii+418. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1938.) 8*s*. 6*d*. net.

THIS new issue is unchanged, except that it contains an account (2 pp.) of Middleton's sodium carbonate-zinc method for detecting nitrogen, halogens and sulphur in organic compounds, with the addition of some useful tables of physical constants (m.p. and b.p.) of organic compounds (12 pp.). The publication of a second edition of this work two years after its original appearance testifies to its fundamental soundness. It meets admirably the requirements of general degree courses in practical organic chemistry, and may be heartily recommended also to more junior students.

J. R.

Principles of Genetics

By Prof. Edmund W. Sinnott and Prof. L. C. Dunn. (McGraw-Hill Publications in the Botanical Sciences.) Third edition. Pp. xiv+408. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 21*s*.

WITHOUT an appreciable increase in size, this edition includes adequate treatment of recent work, such as position effect, somatic crossing-over, salivary-gland chromosomes, cytoplasmic inheritance and heterosis. This has been achieved by considerable rewriting, which appears to have improved the text. This third edition contains a remarkably complete and well-illustrated simple statement of the elements of genetics for biological students. The subjects of crossing-over and the chromosome theory of heredity, highly important in modern genetics, are dealt with particularly well.

F. W. S.

Fission of Heavy Nuclei: a New Type of Nuclear Disintegration

By Dr. N. Feather, Cavendish Laboratory, Cambridge

THE first indication that the transmutation of heavy nuclei could be effected in a laboratory experiment was obtained by Fermi in March 1934. Curie and Joliot had just discovered that short-lived radioactive species are produced as the result of α-particle bombardment of certain light elements, and Fermi, accepting the appearance of such 'induced' radioactivity as proof of transmutation, very soon showed that the nuclei of almost all elements, even those of highest atomic weight, undergo transformation when neutrons are used. From his early experiments Fermi concluded that in general the neutron is simply captured by the nucleus, and he went on to show that this process of capture is usually more efficient—and sometimes very much more efficient—when the neutron is moving with a small ('thermal') velocity, before the collision, than when its energy is large. Eventually he found that negative electrons were emitted in the disintegration of the radioactive products obtained in all these capture transformations, and thus the final result of the combined process of neutron capture and β disintegration was in every case shown to be the production of a nucleus having both mass and charge numbers greater by one unit than the mass and charge numbers of the nucleus bombarded.

In June 1934[1], Fermi and his collaborators obtained negative electron activities from thorium and uranium under neutron bombardment, and they quite naturally supposed, on the basis of their previous investigations, that in the latter case a nuclear species of atomic number $Z = 93$ must remain after disintegration of the unstable product first formed. Further examination showed that not one but several distinct radioelements were produced as a result of the bombardment of uranium, and rough chemical tests proved that one of these, at least (half-value period $\tau = 13$ minutes), was not attributable to an element of atomic number $Z = 92$, 91, 90, 89, 88, 83 or 82. It seemed quite clear, then, that after the uranium nucleus had captured a neutron, not less than two β transformations followed, and consequently that a new element, for which Z was not less than 94, was ultimately produced. These conclusions at once gave rise to much argument amongst chemists as to what the chief chemical properties of these hypothetical transuranic elements might be, but a great deal of careful research in many physical laboratories throughout the world only served to strengthen the assumption that, apart from any preconceived ideas about chemical behaviour, such elements were certainly formed when uranium was bombarded by neutrons.

By May 1937, Meitner, Hahn and Strassmann[2] had recognized the existence of nine separate species arising from this transformation, and had suggested genetic relations between them which supposed that every element of atomic number between (and including) 92 and 97 was represented, either as intermediate or end product of a series. They identified three of these nine products ($\tau = 10$ sec., 40 sec., 23 min.) as unstable isotopes of uranium, and the remainder, which could all be obtained by precipitation with platinum as sulphide in acid solution, as the transuranic elements already mentioned. The scheme presented certain difficulties, it was admitted, (no evidence for the final return of the unstable nucleus within the ordinary range, Z less than 93, could be found, and awkward questions concerning isomeric forms were raised in an acute form) but it was the best that could be done.

Then, in October 1937, Curie and Savitch[3] discovered a tenth activity of about 3½ hours period, and at once proceeded to investigate the chemical nature of the element to which it belonged. They showed that this radioelement did not separate with the platinum precipitate and soon discovered that it bore a close resemblance to lanthanum in chemical behaviour. At first the most plausible suggestion appeared to be that the new species was an isotope of actinium ($Z = 89$). Then two very disturbing facts were encountered. First, a body of the same period and almost identical properties was among the active products formed in the disintegration of thorium by neutrons, and, secondly, it was found possible to separate actinium almost completely from the new body by a lanthanum fractionation. In September 1938, Curie and Savitch[4] wrote, "On the whole, the properties of R 3·5 h. are those of lanthanum, from which it appears that until now it has not been separated".

The work of Curie and Savitch immediately prompted a further search for activities belonging to elements of atomic number less than 92 produced in the uranium transformation, and, as a result, Hahn and Strassmann[5] discovered two other lanthanum-like and three barium-like products. These workers believed that they had

demonstrated the production of each of the former species from one of the latter, but at that time they still inclined to the view that actinium and radium isotopes were really in question. However, in January of this year, they reported[6] that fractionation of the new bodies with mesothorium and barium (or lanthanum) invariably concentrated the neutron-produced activity with the lighter carrier and resulted in a complete separation of mesothorium 1 (radium), or mesothorium 2 (actinium). The conclusion now appeared inescapable that active isotopes of barium and lanthanum were among the products of the bombardment of uranium with neutrons.

At this stage, Meitner and Frisch[7] discussed the problem on the Bohr theory of heavy nuclei, making particular use of the essentially classical 'water-drop model' of the highly condensed system of particles of which such a nucleus is constituted. They concluded, "It seems therefore possible that the uranium nucleus has only small stability of form, and may, after neutron capture, divide itself into two nuclei of roughly equal size. . . . These two nuclei . . . should gain a total kinetic energy of *c.* 200 Mev. . . . This amount of energy may actually be expected to be available from the difference in packing fraction between uranium and the elements in the middle of the periodic system". Then Frisch[8] obtained direct evidence for the projection of fission fragments with approximately the energy predicted, being able to detect the production of large bursts of ionization in a uranium-lined ionization chamber which was irradiated by neutrons. Similar results were obtained when thorium was substituted for uranium in the chamber, and it was concluded that some of the activities previously ascribed to isotopes of radium and actinium, in this case also resulted from fission of the nucleus under neutron bombardment.

The investigations begun by Meitner and Frisch were rapidly followed by many others in physical laboratories both in Europe and in the United States: the confirmation of the findings of Curie and Savitch by Hahn and Strassmann had indicated quite clearly to many workers that something new was involved. In Paris, in Berkeley, in Washington, New York and Baltimore, direct proof of the fission of uranium and thorium was obtained within the space of a few days. Now, some three and a half months after the original announcement, so much has been published that rigorous selection is necessary in any report on the subject. For the remainder of this survey, therefore, only the most interesting features of the new phenomenon can possibly be included.

Perhaps the first such feature concerns the radioelements of the platinum precipitate, of which the previously supposed transuranic nature was now in question. Before the fission process was discovered, both in Berkeley and in Cambridge projects had already been formed of investigating these elements for natural X-radiations, in the hope of being able to deduce the atomic number from the energy of the radiations (natural *L*-radiations) as determined by the method of critical absorption. This problem became much simpler once the presence of medium-heavy elements was suspected, since *K*-radiations could be looked for, instead of the more complex radiations of the *L*-series. Almost at once, Abelson[9] and Feather and Bretscher[10] found evidence for the natural *K*-radiations of iodine from the long-lived activities of the platinum precipitate, and, guided by this observation, were able to identify chemically as tellurium and iodine two products previously described as eka-iridium and eka-platinum, respectively. Then several workers found other of the so-called transuranic activities in the products collected by recoil from bombarded uranium. Observations concerning the rates of decay of these recoil activities[11]—and the results of chemical tests[12]—left little doubt that almost all the previous assignments had been seriously in error. At the present time, one might justly say that it cannot definitely be maintained, concerning any of the activities separable from uranium, that it does not arise in a process of fission of the uranium nucleus.

There is, however, one important activity, of 23 minutes half-value period, which is not separable from uranium and for which, in consequence, the fission process cannot be assumed to be responsible. This non-separable activity arises in a process of resonance capture of neutrons of about 25 ev. energy, and the fact that negative electrons are involved must clearly indicate that a species for which $Z = 93$ is formed as the result of the disintegration. Yet, in spite of much careful investigation, no radioactivity of any kind has been discovered which is unquestionably due to the transformation of this species. Furthermore, in respect of the parent species (the uranium isotope for which $\tau = 23$ min.), this is clearly a quasi-stable modification of the body which undergoes fission in the majority of cases, and Meitner and Frisch and Bohr[13] have discussed this aspect of the phenomenon. They have pointed out that there is nothing intrinsically incomprehensible in the occurrence of resonance capture (emission of γ-radiation) rather than fission in certain circumstances. In any event, division of the nucleus into two fragments must be preceded by the concentration of the available energy in a type of nuclear motion of large deformation, and this concentration may be very unlikely if the original state of the system, after capture of the neutron, is one of

considerable symmetry. Or if, as Bohr has assumed, the effect of thermal neutrons in producing fission in the case of uranium (such neutrons are quite ineffective when thorium is bombarded) is ascribed to capture by the rare isotope ^{235}U, and the resonance effect and the fission process due to fast neutrons are ascribed to ^{238}U, it may even be that, at the resonance energy, the compound nucleus is not formed with sufficient energy of excitation for the neutralization of the small stability of form which it naturally possesses. As regards the whole of this question, more definite conclusions must clearly await further experiments: Joliot[11] has reported a variation in the relative proportions of the different fission products as the energy of the neutrons is altered—and this might be held to favour the suggestions of Bohr—but Bjerge, Brostrøm and Koch[13] have failed to establish any difference in the decay of the products obtained with high-energy neutrons and thermal neutrons, respectively.

Hitherto, the process of fission has been spoken of without any precise statement regarding the nature of the fragments which result from the primary act of division of the nucleus, and in fact very little exact knowledge is as yet available on this point. Determinations of the range of the fission products provide some information. In the first place, they indicate that (with uranium and fast neutrons) the process occupies less than 5×10^{-13} sec. from the time of capture of the neutron (the forwards range is slightly greater than the backwards range, showing that very little of its original momentum is lost before the compound nucleus divides[14]), and, secondly, they appear to favour a very small number of competing primary processes, rather than a large number of possibilities[17]. On the other hand, chemical investigation reveals such a wealth of active products[18] (with atomic numbers lying between 35 (Br) and 57 (La), if not more widely distributed) that some adequate explanation of their complexity must certainly be found. It would appear that the discovery that very frequently neutrons are emitted almost instantaneously by the original products of fission[19] already provides a basis for such explanation (nuclei, first formed, presumably, in states of high excitation, emit either neutrons or quanta of radiation in passing to longer-lived states). Also, even after these states have decayed with β-emission, experiment shows that occasionally product nuclei result, still with sufficient energy of excitation for the 'evaporation' of neutrons to be a possible alternative to radiative transitions leading to more stable states. In this connexion, Roberts, Meyer, and Wang[20] and Booth, Dunning and Slack[21] have reported delayed neutron periods of about 12 sec. and 45 sec., when uranium is bombarded, whilst a similar feature has also been established in the case of thorium.

The frequency of the neutron-evaporation process accompanying fission, and the energies of the neutrons so produced, have been studied by many workers, but so far most exhaustively by Joliot[22] and his colleagues, and by Fermi[23] and others in New York. The general result appears to be that, for each process of fission with uranium, at least two neutrons, having a mean energy of the order of 10^6 ev., eventually evaporate from the residual fragments. Since neutrons of less than this energy are still capable of producing fission on their own account (probably in ^{235}U, as already suggested), the possibility of a cumulative process of exothermic disintegration has to be considered. Clearly, if the probability of removal of neutrons in processes other than those which result in fission is sufficiently reduced, the latter process must eventually build up in any solid substance containing uranium. Direct experiments on this aspect of the matter have not yet been reported in the scientific literature, but at this stage it may be pointed out that, even in pure uranium, it is well known that a non-fission capture process takes place (*v. sup.*), whilst the unlimited generation of energy in the solid material would ultimately increase the energy of the 'thermal' neutrons until their efficiency as agents for fission was greatly reduced. Already several attempts have been made[24] to calculate the course of the phenomenon using existing data, but the assumptions upon which they have been based have generally been so severely idealized that no confidence in numerical values is at present likely to result.

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[2] *Z. Phys.*, **105**, 249 (1937).
[3] *J. Phys.*, **8**, 385 (1937).
[4] *J. Phys.*, **9**, 355 (1938).
[5] *Naturwiss.*, **26**, 755 (1938).
[6] *Naturwiss.*, **27**, 11 (1939).
[7] NATURE, **143**, 239 (1939).
[8] NATURE, **143**, 276 (1939).
[9] *Phys. Rev.*, **55**, 418 (1939).
[10] NATURE, **143**, 516 (1939).
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[17] McMillan, *Phys. Rev.*, **55**, 510 (1939).
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[23] Anderson, Fermi and Hanstein, *Phys. Rev.*, **55**, 797 (1939). Szilard and Zinn, *Phys. Rev.*, **55**, 799 (1939).
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The Concept of Instinct

By Dr. J. A. Loeser, formerly Professor of Psychology, University of Berlin

WHEN a hen has laid eggs for the first time in her life she immediately sits on them. She does not know why she does this for she does not consciously know what an egg is, nor what incubation is, nor can she take any interest in the hatching of the future brood. Hitherto science has called this a typical example of animal instinct. Without any consciousness of the biological purpose, it is said the animal finds the right thing to do because it was born with a mysterious instinct, which is inherited from the experience gained by its ancestors in primeval times.

The Concept of Instinct

What is the real truth of the matter? Careful investigation has proved that the animal certainly has personal motives for sitting, but they are not biological ones. Shortly before the beginning of hatching-time the animal's breast shows the so-called hatching spot. Here the feathers fall out and there is a bald spot which feels hot, as if from inflammation (probably caused by hormones). This evidently causes the animal pain, for it seeks cooling substances, which must necessarily have a curved shape to be effective. After the eggs have been laid, these offer what is required. But we may just as well give the hen stones or billiard balls to sit upon; she will 'hatch' them in exactly the same way, because all she wants is to soothe the discomfort of her body. It is also possible to soothe the 'hatching irritation' in an entirely different way, that is, by holding the animal's breast in cold water. These are experiments which even the peasant knows and often makes for practical reasons. Only a bird which has these 'spots' sits on the eggs, and with many species frequently it is the cock. Similarly, the bird takes no more interest in its own eggs than in those of another bird, if these are put into its nest soon enough to become familiar. There is, therefore, no such thing as purposeful hatching. The hen only sits on her eggs while the irritation from the 'hatching-spot' lasts. When the eggs have been hatched, others may be substituted, and she will continue to sit on them. But when the irritation has ceased, the hen does not continue to sit but forsakes the eggs, which decay.

Usually, however, this subjective conduct on the part of the bird serves a purpose, for the consequence generally is that the eggs are hatched. The hen turns the eggs so that she may sit on the cool parts, and without meaning to do so she thus causes all parts of the egg to be equally warmed.

This example shows animal behaviour in an entirely new light. The conclusions to be drawn from it are the following:

(1) Every animal acts only in accordance with *personal* or *subjective impulses*; it only satisfies its personal needs. The hen merely wishes to soothe the pain of the 'hatching spot'.

(2) The *means* to do this may vary a great deal; they are *fundamentally variable*. It is a matter of indifference to the hen whether she sits on eggs or on other subjects, or whether cold water is used for satisfying her needs.

(3) Biological purposes are not aimed at, either consciously or unconsciously, that is, instinctively. The 'personally' motivated behaviour is often biologically useless or harmful. The hen is indifferent to the fate of the eggs. Frequently, however, subjective (psychological) aims and objective (biological) purposes coincide.

The theory of the *psychological autonomy of action* in all living creatures, which I evolved on these lines a few years ago, cast doubt on all mechanistic conceptions of human and animal behaviour and therefore to the ancient conception of instinct, which had persisted for more than two thousand years. This conception had completely dominated the theory of organic behaviour. All actions were traced to fundamental instincts, even the actions of the apparently free will, for at long last the motives for these too were believed to consist in vital impulses.

In opposition to this conception, the new theory postulates the fundamental 'uniformity of all organic action' from the simplest reaction of the Protozoa to the voluntary action of man. The prototype of all reaction, indeed, is this *voluntary action*. Its principle is variability in the choice of the means to obtain its ends.

The aim of voluntary action is always a personal motive, a psychological experience, which represents the subjective reason for the reaction. The motives themselves may be of an inferior or of a superior nature, that is at present theoretically unimportant. Every organic action, therefore, is merely the satisfaction of an impulse, without

regard to the question as to how far self-preservation and race-preservation, the two impulses generally recognized in biology as the only influential ones, are guaranteed.

These two great unconscious motives in the theory of instinct and all biological psychology must be eliminated; they do not exist; they are neither conscious nor unconscious impulses of organic behaviour. If then there is no instinct as the imaginary basis of action, neither is there instinctive action or reaction, in short no unconsciously suitable action (that is, no action for the purpose of self-preservation or race-preservation); there is no pre-formed reaction which intervenes, as an inherited factor, between the sensation and its expression.

Only in a certain percentage of cases do self-preservation and race-preservation occur in Nature as the *consequence* of purely individual action.

Voluntary and Reflective Action

The first and fundamental question here is the transition of ideas in the line which leads from true voluntary action (or action of the free will) by way of rigid instinct, occasionally modifiable, it is true, yet essentially and fundamentally invariable, to true *reflex action*. If this continuous line cannot be sharply divided, the result will always be: instinct is in the end a reflex-chain and the action of the will is only a relaxed action of the instinct; this was how it was described even in the most recent publications. Instinct is actually only an 'extended organ'—this was the rigid and materialistic conception of what is in truth free responsive action.

So we must first find a short and correct definition of reflex action. It is characterized by movement independent of the personal will, such as is to be found in the action of the internal organs of the body. Reflex action needs a nerve centre the existence of which has in many cases been proved. As it does not emanate from the ego, it is not directed towards the ego's purposes; how far it is biologically useful is another question. But this is not our concern for the moment.

In contrast to these *involuntary* processes *all* others appear as *voluntary actions*, modelled on the true action of the will. To these belong the voluntary closing of the eyelids or voluntary breathing, whereas involuntary breathing is a reflex. To these belong also, however, as I have proved by a number of examples, most of the so-called instinctive actions—not, it is true, taken as a whole (as described in the famous old alternative: conscious action of the will or unconscious action of the instinct), but analysed and broken up into a series of "small voluntary actions".

Thus every true action (action of the free will) is a natural product of all the circumstances, a product consisting of three main factors. That is, *psychological* and *physical* tendencies and abilities can only be effective in the animal's natural *surroundings*. In short, every living creature acts in any given situation so far as possible under the impulse of pleasure or pain.

Sensation and Reaction

Most investigators pay too little attention to the decisive factor, *sensation*, which they generally treat as of minor importance. Instinct is mostly defined as unconsciously purposive activity. But why should there be any sensations, pleasure or pain, and whence do they arise, if they do not cause a reaction and, moreover, a fitting reaction? Does not every living creature, as the simplest observation shows, act in a manner which leads, for example, to the satisfaction of the painful sensation of hunger? On these occasions biologically inexpedient activity frequently occurs, such as the eating of injurious food, only because it has a pleasant taste. It is only personal impulse, that primarily controls and guides action.

A striking example of instinct seems to be that of the *swallow*, the instinct of which appears to impel her to a sticking activity, even when there is no reason for it, when, for example, she has a perfect nest. The sticking is an instinctive impulse, it is said. But birds which build with saliva—swallows as well as nuthatches and salanganes—have special salivary glands, which swell during brooding-time and obviously drive them to secrete the salivary fluid, as is the case with all animal secretion. Alfred Brehm has pointed out that the pain caused by the swollen glands impels the animals to get rid of the secretion of these glands by pressing and rubbing movements. So here, too, there is no question of the irresistible beginning of a purposive instinct but of a subjective activity on the part of the bird, of a significant reaction to a painful stimulus, a reaction which may, however, be purposeless.

One of the chief examples of instinct, the piercing reaction of the lanneret (*Lanius collurio* L.) has since been proved, in complete agreement with my theory, to be the result of suitable actions according to the principle of trial and error, knowledge of the thorn being only acquired after long investigation (Lorenz). Another pillar of the instinct theory has therefore fallen.

A splendid new example of instinct analysis according to my theory is solving the famous problem of the *cuckoo's egg*. This was formerly a problem which evidently defied solution. How is it that the cuckoo's eggs found in other birds'

nests always correspond in colour to those of the owner of the nest? How can the cuckoo sometimes put bluish-green eggs, then again white ones with brown spots, or speckled or unspeckled ones into the strange nest? If the eggs differed from those of the host, they would, of course, be thrown out of the nest. But it is just these fundamental problems that have been solved quite naturally. Each cuckoo has been bred in a certain kind of nest and has been fed with a certain kind of food. This influences the colour of the eggs, for example, the bluish-green colour of the garden redstart's eggs. We now know almost for certain that for the purpose of laying her eggs, the cuckoo generally only chooses a nest like the one in which she herself has been reared and with which she is therefore familiar. This is easily explained. So her eggs are laid beside eggs of a different nature but of the same colour, and are therefore not thrown out by the host but hatched by her. In this way, a particularly complicated problem has been solved in a perfectly natural way in conformity with my theory, according to which purely physiological factors (the same colour resulting from the same food) generally co-operate in these complicated cases with psychologically motivated reactions (choice of the familiar kind of nest). Here, therefore, we have series of truly voluntary actions, and analysis has led to the solution of the problem.

It is therefore evident that there is always a *personal reason* for the action, and that nothing takes place *without* such a motive.

The second decisive point is the *reaction* to emotion. Every action is *always* and *only* the response to an emotion. Where the psychological basis is very narrow and slight and the physical possibilities very unmistakably re-formed, the response may be of an exceedingly stereotyped nature. In such cases the impression gained from superficial observation will be that the actions are really mechanical.

It is well known that ichneumon flies sting strange caterpillars or grubs which they find beneath the bark of a tree. The explanation of this mystery was found by means of an experiment which once more proved the exclusive effect of personal impulse. In this case, the impulse was provided by the smell of the victims. It was proved that the ichneumon flies also stung small paper cornets filled with the blood of the caterpillars or grubs, this blood providing the characteristic smell. If there were an instinct or some complete reaction unconsciously serving a vital purpose, it would necessarily *include* the strange insect as the *object* of the action, for without this insect as its object the action itself would be useless. It is therefore clear that here too the stimulus merely leads to its own satisfaction irrespective of any object or purpose, whereupon a true inner organic reflex action takes place, which causes the laying apparatus to function.

The well-known experiment made in Germany a few years ago with *young storks* in order to submit their instinct to an *experimentum crucis* ended in a real catastrophe for this conception. The birds, which had been brought from east Prussia to the Rhine and which had not hitherto migrated, should have moved in a south-easterly direction, according to the instinct theory. This is usual with storks the home of which is in eastern Germany, a fact hitherto explained by the 'instinct of direction', that is a south-easterly instinct. The result, however, was that the storks scattered in all directions. Some were sighted in the Alps, some in France, but not a single one in the east. The reason for this is that all the storks in eastern Germany, being 'water-birds', must naturally move along the river valleys, etc., where they find their food, and finally in the direction of the Black Sea, and the Bosphorus, whereas when taken to western Germany they pursue the opposite course, that is, like the west-German storks, they fly along the Rhine-Rhone valley to the western Mediterranean and North Africa. In this case, however, the most natural thing was for them to scatter, as storks, 'traditional flyers', mostly migrate under the leadership of old ones, and this leadership was lacking.

THE PROBLEM OF PURPOSE

In all these occurrences in Nature as well as in all experiments, we have repeated evidence of the uncertainty with which biological aims are achieved. A glance at 'fundamental instincts' will prove this; for example, the important and decisive *food instinct*, where the fundamental divergence between the significant reaction to stimuli (taste and smell) and the biological utility of this procedure is clearly evident. Every living creature, from the protozoon to man, directs its actions primarily and exclusively according to such subjective stimuli; only in the second place does the problem arise as to how far satisfaction of the stimulus is conducive to health. Even in the animal kingdom this problem may become a momentous one, as when certain tribes of ants cause the downfall of their community through excessive consumption of the intoxicating secretion of the plant-louse. It must be remembered that there is no question here of *abnormal behaviour*. On the contrary, it is in such extreme cases that the fundamental law is most clearly evident, the law of reaction to a sensation.

The frequently destructive behaviour in the animal's *care of its young* is perhaps the most

striking example of all. The fact that with many species the devouring of eggs and offspring is not an abnormality, but almost a normal procedure, as with ants, bees, bumble-bees, also with some kinds of fish, is clearly in favour of the exclusive principle of the subjective satisfaction of impulse, a principle which rules even in opposition to elementary biological purposes.

On the other hand, I have already given a detailed description of cases in which 'genuine' care of the brood, that is the care of the young animal itself, as well as genuine friendship and love in animals, are found.

With regard to the problem of the so-called instinctive goal, *migration of birds* of passage is of special interest. It used to be said that the true migratory instinct determined both, the *passage* and its *destination*. But there is scarcely another instance which proves so unmistakably that all is variable. At most it can be said that the impulse of flying is constant, the impulse which is the fundamental phenomenon of the migration, and which I have already described in detail elsewhere. This impulse signifies the beginning or breaking forth of a *completely undirected* storm of motion—probably due to the action of hormones. In this storm the moving stimulus is once more recognizable, the stimulus to which all migration is the natural reaction. But the two factors essential to the instinct, that is, the *way* and the *goal*, are by no means pre-formed. On one hand, suitable adaptation to circumstances is again possible, leading to the only action which is biologically (relatively) expedient. On the other hand, the loss is naturally very great, due to the difficulties of the flight and to the inadequate intelligence of the birds, which are not able to gauge the difficulties that face them. Frequently they make fatal mistakes, as when the great flocks of singing birds fly over the Black Sea by night and perish in thousands, because their wings are frozen. The bird knows nothing, it neither recognizes its danger consciously, for it evidently does not even know that it is flying over a great expanse of water, nor does instinct guard it unconsciously, but all the more surely, from destruction.

Results

So the nature of organic action proves to be quite different from what has always been assumed. For the assumption of instincts makes the living creature an automaton, which, if properly constructed, cannot make mistakes. (The famous struggle for existence constitutes only an apparent exception. For it is those individuals who have been most favourably predisposed from the beginning which automatically survive through the process of selection. There can scarcely be any question of a real struggle.) The theory which I have propounded, that of the *risk* of organic life, is something fundamentally different. For every organism, from the lowest to the highest, acts in conformity with it, according to the same principle of adaptation to circumstances under the ægis of subjective impulses and experiences. Thus we have genuine reflection and genuine risk. We also have error as a necessary ingredient of life, not as the abnormal breaking-down of an automatic machine. A real risk, and in consequence a real struggle worthy of the name, are only possible where there is that which in its highest sense is called free will. It always rests on the same principle—the possibility of *selection* among various reactions. What we term *psyche* or *consciousness* is needful, that is real psychological experience, the recollection and estimation of which leads to the corresponding action.

What becomes of organic purposiveness? The only thing we must state as an indisputable fact in Nature is the presence of a certain pre-formed harmony. Every living creature is born with an organism which enables it to exist within certain limits. Part of this constitution is a disposition to experience certain stimuli. The fact that sugar has a sweet taste and therefore a pleasant one rests on constitutional factors. But the behaviour which satisfies such pleasurable impulses and wards off painful ones is by no means, and cannot be, pre-formed, for the ever-changing circumstances of life necessitate a constantly renewed adaptation to them.

I must once more state emphatically that the instinct hypothesis is in direct contradiction to every result of the modern theory of heredity. It has been proved again and again that only a certain disposition to receive impressions on one hand, and to general emotional attitude and bent of mind on the other is inherited; for example, a profoundly emotional nature or a generally intelligent disposition. We have never known, especially in practical life, anything like an inborn impulse to action or hereditary knowledge. We may inherit a talent for languages, but not a knowledge of French. Neither can knowledge that an object is there for a special purpose be inherited; for example, the hen has not inherited the knowledge that sitting on an egg will hatch it. We see that man's knowledge and actions emanate from his mental and emotional disposition and as their result, but nothing more. There is no 'born murderer' as such, except in so far as a man is predisposed to murder by his general mental and emotional life. Instinct has been defined as 'inherited experience'. Science has proved that such a thing does not exist.

The Aurora Polaris and the Light of the Night Sky

THE relation of the aurora to the light of the night sky formed the topic of a Geophysical Discussion at the Royal Astronomical Society on May 19, under the chairmanship of Lord Rayleigh. Prof. S. Chapman opened the discussion.

Owing to its often striking appearance, the aurora polaris has long been studied. Dr. J. M. Stagg gave an account of its appearance and changes as observed at Fort Rae, near the auroral zone, during the second International Polar Year (1932/3); one remarkable feature he described was the occasional repetition, on two successive nights, of unusual and distinctive auroral appearances.

The situation of auroral arcs and rays and sheets and diffuse clouds has for many years been determined with considerable accuracy by the methods introduced by Prof. C. Störmer, whose long-continued and fruitful work was rewarded, not long since, by the discovery that the very high auroras, extending up to 600 km. or even more, are generally in the part of the atmosphere which, though visible from the ground after sunset or before sunrise, is still illumined by the sun's rays.

Naturally, the auroral light was also examined by the spectroscope; the spectrum includes several bands, some of which have long been known to be the so-called negative bands emitted by excited positive molecular ions of nitrogen (N_2^+); in addition, it contains a bright yellow-green line.

A similar line was found to be present in the light of the night sky. But in other respects this light differs considerably from the auroral light, as was first clearly emphasized by Lord Rayleigh; it does not contain the N_2^+ bands: it is diffuse and formless, but always present, in all latitudes; its variations are much less rapid and less great than those of the aurora.

The wave-length of the green line in the night-sky spectrum was determined very accurately in 1923 by Babcock, using an interferometer; it is 5577·35, and its width is very small, only 0·030 A. A few years ago, Harang and Vegard (who has been one of the most assiduous and successful workers on the auroral spectrum) determined the wave-length of the green auroral line in the same way, and thus proved that the line is the same in the two spectra. These interferometer measures show that the line is of atomic origin and not part of a molecular band. Harang and Vegard have also demonstrated the atomic character, and found the accurate wave-lengths, of two red lines, 6300 and 6364, in the auroral spectrum.

The same two lines, and also the yellow doublet of neutral atomic sodium, have been observed interferometrically in the night-sky spectrum; this was done in France, where several spectroscopists of the highest skill—Cabannes, Dufay, Gauzit and Bernard—are studying this light. The lines named above are the only ones in the auroral or night-sky spectra the atomic character of which has been established by use of the interferometer. The suspected presence of a line due to atomic nitrogen has not yet been confirmed or disproved by this method.

Recent years have seen a great advance in the accuracy with which the lines and bands in the two spectra are measured, and in the range of the spectrum observed. For the night sky, the observations have been extended far into the ultra-violet (notably by Gauzit) and into the infra-red (by Slipher). Gauzit has made the remarkable discovery that the night-sky spectrum extends to at least 2950 A. in the ultra-violet; he suggests that this light comes from the lower part of the ozone layer, which would absorb such light if it came from above (as it absorbs the sunlight of that wave-length, during the day).

The origin of the green line 5577 long remained mysterious, and it was not produced in the laboratory until 1925, when McLennan, with Ireton, and others of his Toronto fellow-workers, began a brilliant series of researches which, aided by other discoveries of the time, by Frerichs, Rubinowicz, and Bowen, established that the line is due to neutral atomic oxygen. The atomic transition involved is from the metastable $^1S_0$ state, with a mean life-time of about 1 second, to a $^1D_2$ state, lifetime about 100 seconds, these times having been calculated by Stevenson; transitions from the latter state to the (multiple) ground state $^3P_{012}$ give the red lines 6300, 6364 already mentioned. Thus the nature of the atomic lines in the auroral and night-sky spectra is now definitely ascertained.

Kaplan's laboratory experiments on nitrogen mixed with oxygen have closely reproduced the two spectra, and in particular have led to the recognition and understanding of some of the principal (Vegard-Kaplan) bands in them. Though some important bands still remain unidentified, it seems likely that all the principal bands, in both spectra, are due to molecular nitrogen (neutral in the night-sky spectrum, and both neutral and ionized in the auroral spectrum). The two spectra differ greatly in the degree of excitation involved, that of the night-sky spectrum (about 7 volts)

being much less than for the auroral spectrum (about 20 volts).

Dr. W. C. Price described the energy-level diagrams for nitrogen and oxygen, indicating the nature of the various nitrogen emission bands, and also explained how the oxygen molecules, but not the nitrogen molecules, become dissociated by sunlight in the high atmosphere; both also become partly ionized, the nitrogen in the *F* layer and the oxygen (O_2) in the *E* layer. The energy of the night-sky light probably comes from the re-combination of some of the oxygen atoms throughout the night, and Chapman has outlined the processes by which this energy can be transformed into the observed light. The auroral light is probably due to the impact upon the molecules in the high atmosphere of fast-moving particles coming from the sun.

The temporal variations in the intensity of the night-sky light have been studied in a remarkable series of researches, carried on for eleven years under the exceptional difficulties of English skies, by Lord Rayleigh. He devised a simple instrument, which was described by the Astronomer Royal, containing a permanent weak comparison light-source (a radioactive uranium salt) and which by means of six simple colour filters enabled the intensity of the faint night-sky light, in three spectral regions, to be estimated within a range of no fewer than thirteen grades. Copies of this instrument were used by other observers, and notably for about eight years at the Cape and Canberra Observatories, in a co-operative research organized by Lord Rayleigh. Variations of annual, semi-annual and eleven-year (sunspot) periods were observed, as well as irregular day-to-day changes. McLennan, and independently Lord Rayleigh, also found a variation during the night, with maximum at 12 or 1 p.m., which has since been confirmed also by Russian observers. In addition, Lord Rayleigh made the very difficult determination—of great theoretical interest—of the absolute photometric intensity of the green night-sky light (5577); this indicated that $1{\cdot}8 \times 10^{12}$ atomic oxygen transitions ($^1S_0$ to $^1D_2$) occurred per second in each square centimetre column of the atmosphere.

In Lord Rayleigh's own contribution to the discussion, he stressed the difficulty of work on the night-sky spectrum, owing to its faintness, which makes it impossible, in the ordinary way, to get luminous spectra with much dispersion, unless large and expensive prisms are used. He considered that his father's tube-spectroscope might find a useful application in this field; this instrument consists of a tube, with lenses at each end, which contains numerous, perhaps twenty, glass prisms in a liquid, carbon disulphide, of very similar refractive index; it can give great dispersion with little loss of light.

Obituary Notices

Sir Robert Bolam, O.B.E.

THE death of Sir Robert Bolam, which took place at his home in Newcastle-upon-Tyne on April 28, not only removes an outstanding personality of the medical profession from the north of England, but also one who by reason of his activities in larger spheres of medical interest had made a name known and respected in the profession all over Great Britain.

Bolam's name will always be connected with the two bodies to which he gave such long and valued service, the General Medical Council and the British Medical Association. He was first a member of the General Medical Council in 1920, being elected as a direct representative for England; then from 1928 until his death he represented the University of Durham. It was only natural that his acumen and capacity for attention to detail led ultimately to his appointment as Chairman of Business, and this no doubt, had he lived, would have been followed by yet higher honour in the Council.

In the British Medical Association, Bolam was an active member for forty years, and here again his administrative ability, shrewdness and clear thinking soon brought him into prominence. He became a member of Council in 1915, acted as chairman of the Journal Committee and of the Hospitals Committee; finally in 1920 he became chairman of the Council. His energy and initiative were responsible for the transfer of the Association's headquarters in London from the Strand to its present site in Tavistock Square. In this move to what is now rapidly becoming the intellectual quarter of London, Bolam displayed foresight and faith which have since been justified abundantly.

In spite of the energy which Bolam expended in the services to the General Medical Council and the British Medical Association, either of which would have been an ample occupation for a man of normal activity and talents, he gave his best services over a long period of years and in many capacities to his old school, the University of Durham College of Medicine and the associated Royal Victoria Infirmary. The posts he held were various; in the College of Medicine he was in turn lecturer on physiology and pathology, joint lecturer on physiological physics and chemistry, professor of medical jurisprudence, sub-curator of the museum, while in the Infirmary he was assistant physician and pathologist. Later he

became the first honorary physician in charge of the Skin Department and held this position until his retirement from the Infirmary staff in 1931. The accompanying lectureship in dermatology in the College of Medicine he held from 1914 until 1937.

But as in London, so in Newcastle, Bolam was outstanding in his committee and administrative work. He was an active member of the senate of the University for many years and in 1931 was made pro-vice-chancellor, and was vice-chancellor in 1936–37. He acted as registrar of the College of Medicine in succession to Prof. R. Howden, and in 1934 was elected its president.

During the years following, Bolam's main object was to see the College rehoused on a site facing the Royal Victoria Infirmary, and to this task he applied himself with his customary vigour and enthusiasm.

Following the merging of the College of Medicine and Armstrong College into the present King's College in the University of Durham, Bolam continued as chairman of the Building Board, in which capacity he was able to see the realization of his dreams. In spite of periods of ill-health during the last six months, he was able to receive H.M. King George VI and H.M. the Queen and to conduct them around the finished building on the occasion of the official opening in February of this year.

An obituary of a man of such widespread activity as Sir Robert Bolam must necessarily tend to take the form of a catalogue of his services, in the recital of which the personal character is not given due weight. To those who knew him well, the memory of Bolam will be found not in a monument of brick or stone, not in the records of the minute books of the many committees on which he served or which he directed, but in the personal memory of the man himself. In this, his statesmanship, sincerity and directness of purpose will be remembered, but his never failing courtesy and kindness will above all be abiding to those who may claim to have been honoured by his friendship. R. B. GREEN.

Sir William Butler, Bart.

THE death on April 5 of Sir William Waters Butler, Bart., deprived Birmingham, its neighbourhood and its University, of one of their most generous philanthropists.

Educated at King Edward's School, Birmingham, Sir William entered his father's business, which later became Mitchells and Butlers, Ltd., brewers. Further studies in the sciences were pursued at the evening classes held at the Midland Institute, and he became a fellow of the Chemical Society. To the last he maintained an interest in the technology of his trade, and on more than one occasion told me that the most pleasant times in his routine week were spent in the brewery discussing technical matters on Sunday mornings when the distractions of workaday business activities could be temporarily banished.

The British School of Malting and Brewing at the University of Birmingham, set up by subscription from a number of brewing firms in 1899, was strongly supported from the first by Sir William's firm. In 1919, he initiated the endowment of the Adrian Brown chair of brewing, and in 1926 personally defrayed the entire cost of the new Department at the Edgbaston site. Without this donation, the erection of the new biology block there would have been virtually impossible. He also made repeated donations to various departments of the University; two of his most recent ones, £10,000 each, were respectively for the endowment of scholarships in science and commerce and for the University Medical School. In addition he had served since 1917 on the Council of the University, and was known to possess wide sympathies in all educational matters, and to be ever ready with business advice and help.

R. H. HOPKINS.

Mr. G. E. Blundell

THE National Museum of Wales has lost a good friend by the death of Mr. G. E. Blundell. For many years science master at Wellington College, Blundell retained his interest in scientific matters when he became lord of the manor at Newton Nottage near Porthcawl, paying special attention to chemistry and geology, and eventually to archæology. He was a keen observer, always ready to bring new discoveries to the notice of those to whom the information was likely to be useful, with the result that although he seldom published the results of his own investigations, he contributed much that was of real value to the work of others.

It was this generous attitude that brought Blundell into contact with the National Museum of Wales. In 1922, when the Museum was preparing to open its doors for the first time, he became a member of the committee concerned with archæological matters, and in 1926 he was elected to a seat on the Council.

As an example of Blundell's indirect contributions to archæology we might take the discovery, made in association with his wife (a daughter of the late R. H. Tiddeman of the Geological Survey), of bronze objects and fragments of crucibles with adherent bronze, associated with fragments of iron and slag, pot-boilers and bones, in the sand dunes at Merthyr Mawr in Glamorgan. This proved to be the first Early Iron Age settlement to be found in Wales, and it was afterwards described by (Sir) Cyril Fox in "Archaeologia Cambrensis" in 1927.

To geology, Blundell rendered useful service by recording excavations made in the vicinity of his home, and by his interest in the early history of the subject. The latter is understandable since he was related to the descendants of William Buckland, and as a result of it, interesting manuscripts relating to Buckland's work in Wales have been deposited in the National Museum of Wales by Dr. Mervyn H. Gordon, one of the Dean's grandsons. F. J. N.

WE regret to announce the death of Prof. S. L. Loney, professor of mathematics in the Royal Holloway College (University of London), from 1888 until 1920, on May 16, aged seventy-nine years.

News and Views

Dr. E. D. Merrill

THE Linnean Medal of the Linnean Society of London was presented to Dr. E. D. Merrill through a representative of the American Embassy on May 24. When in 1900 the new administration of the Philippines established a scientific service, Elmer Drew Merrill, then fresh from college, was one of those appointed. The botanical position there had been rendered difficult because of two fires; one in 1897 had destroyed the herbarium of the Forestry Bureau, Manila, and the other had destroyed the herbarium of the Guadalupe Convent during the Spanish-American War of 1899. Thus in the space of two years the work of Vidal and of the priests who had followed Blanco was largely obliterated. The problem facing young Merrill was one which would have daunted many much more experienced taxonomists, but he faced it with characteristic energy and common sense. To know what the older explorers had found and described necessitated visiting the same areas and making large collections. Thus not only did he collect in all parts of the Philippines as they became accessible, but also the extensive herbarium he built up contained specimens from all adjoining areas. His first administrative post was that of Director of the Bureau of Science, Philippine Islands, to which he was appointed in 1919. He rounded off his botanical work for the islands by the publication of "An Enumeration of Philippine Flowering Plants" (1925–26) in four volumes.

IN his intensive studies of the Philippine flora, Dr. Merrill did not confine his attentions to Philippine plants but investigated also the neighbouring Indo-Malayan floras. Borneo, Amboina (where Rumphius had worked in pre-Linnean times), and Indo-China (where Loureiro had botanized) all received his attention. His "Bibliographic Enumeration of Bornean Plants" appeared in 1921, and at intervals between 1917 and 1935 he published his invaluable interpretations of the species of the earlier Asiatic botanists whose specimens, from one cause or another, had largely disappeared. In 1917 came his "Interpretation of Rumphius's Herbarium Amboinense", in the following year his "Species Blancoanæ", in 1921 his "Review of the New Species of Plants Proposed by N. L. Burman in his Flora Indica", and in 1935 his commentary on Loureiro's "Flora Cochinchinensis". Since leaving the Philippines Merrill has filled arduous administrative posts, first as dean of the Faculty of Agriculture in the University of California, then as director of the New York Botanic Garden and now, as administrator of botanical collections of Harvard University. In all these he has worked with the same energy and success. At the same time he has contrived to do what many holders of high administrative posts find impossible: to continue his old scientific work. During this latter period he has turned his attention chiefly to the botany of south-eastern China, and in collaboration with the enthusiastic young Chinese botanists has published numerous contributions on the flora of the region; and only a year ago he published, with E. H. Walker, a comprehensive "Bibliography of Eastern Asiatic Botany", of more than seven hundred pages.

Rev. E. O. James

THE Rev. Ernest Oliver James, professor of the history and philosophy of religion in the University of Leeds since 1933, has been appointed Wilde reader in natural and comparative religion in the University of Oxford for a period of three years as from October 1 next. Dr. James is well known for his studies in comparative religion in the school of Robertson Smith and Sir James Frazer. He was president of the Folk-lore Society in 1930–32, has edited *Folk-Lore* since 1932, and presided over the section of religions in the International Congress of Ethnological Sciences which met in London in 1934. In 1916–20 Dr. James acted as a secretary of the Anthropological Section of the British Association, and in 1928 was an extra-mural tutor in anthropology in the University of Cambridge. From 1911 until his appointment to a professorial chair, Dr. James was engaged in pastoral work in the Church, among the parishes of which he was incumbent being Limehouse in the East End of London, where between 1917 and 1921 his activities in eradicating the gross abuses prevalent among the Chinese population attracted no little public notice. He is the author of a considerable number of works on anthropological topics, among which may be mentioned "Primitive Ritual and Belief" (1917), "An Introduction to Anthropology" (1919), "The Stone Age" (1927), "The Origins of Sacrifice" (1933), "Christian Myth and Ritual" (1933), "The Old Testament in the Light of Anthropology" (1935) and "Introduction to the History of Religions" (1938).

U.S. National Academy of Sciences: Medal Awards

THE following medals of the National Academy of Sciences were presented at the annual dinner of the Academy on April 25: *Agassiz Medal*, for oceanography, awarded to Harald Ulrik Sverdrup, of the Scripps Institution of Oceanography of the University of California, La Jolla, for his personal oceanographic explorations in Arctic regions and his numerous contributions to physical oceanography and the interrelations between the sea and the atmosphere; *Daniel Giraud Elliot Medal for* 1933, and accompanying honorarium of 200 dollars, awarded to Richard Swann Lull, of the Peabody Museum of Natural History, Yale University, in recognition of his work entitled: "A Revision of the Ceratopsia or Horned Dinosaurs", published in the *Memoirs* of the Peabody Museum of Natural History; *Daniel Giraud Elliot Medal for* 1934, and accompanying honorarium of 200 dollars, awarded to Theophilus Shickel Painter, of the University of Texas, in recognition of his work

on the chromosomes of the salivary glands in *Drosophila* in relation to the problems of mutation and genetics, published in *Genetics* and the *Journal of Heredity* in 1934; *John J. Carty Medal*, and award for the advancement of science, consisting of a gold medal, bronze replica, certificate and 3,000 dollars, awarded to Sir William Bragg, of the Royal Institution, London, for his fundamental work in X-ray crystal analysis; he has shown how to reveal the constitution of crystalline forms and accurately measure them, and his studies have given birth to a new tool which is bringing to light important facts regarding such complex structures as the larger organic molecules.

U.S. National Academy of Sciences: Elections

AT the annual meeting of the National Academy of Sciences, Dr. Frank B. Jewett, president of the Bell Telephone Laboratories, was elected president for a term of four years, to succeed Dr. Frank R. Lillie, emeritus professor of zoology of the University of Chicago, who will retire on June 30. The following were elected members of the Academy: Gregory Breit, professor of physics, University of Wisconsin; Detlev Wulf Bronk, Johnson professor of biophysics and director of the Johnson Foundation, University of Pennsylvania; William Bosworth Castle, associate professor of medicine, Harvard Medical School, director of the Thorndike Memorial Laboratory, Boston City Hospital; Frederick Gardner Cottrell, president, Research Associates, Incorporated, Washington, D.C., consulting chemist, Bureau of Chemistry and Soils; Frederick Parker Gay, professor of pathology and bacteriology, College of Physicians and Surgeons, Columbia University; Albert Baird Hastings, Hamilton Kuhn professor of biochemistry, Harvard University; Vladimir Nikolaevich Ipatieff, research director of the Universal Oil Products Company, professor of chemistry, Northwestern University; Merkel Henry Jacobs, professor of general physiology, University of Pennsylvania; Zay Jeffries, General Electric Company, Cleveland, Ohio; Donald Forsha Jones, geneticist, Connecticut Agricultural Experiment Station, New Haven; George Bogdan Kistiakowsky, professor of chemistry, Harvard University; Warren Judson Mead, professor and head of the department of geology, Massachusetts Institute of Technology; Oscar Riddle, investigator, department of genetics, Station for Experimental Evolution, Carnegie Institution, Cold Spring Harbor, N.Y.; Adolph Hans Schultz, associate professor of physical anthropology, School of Medicine, the Johns Hopkins University; Philip Edward Smith, professor of anatomy, College of Physicians and Surgeons, Columbia University.

THE following were elected foreign associates: Sir Joseph Barcroft, professor of physiology, University of Cambridge; Sir William Bragg, director, Royal Institution of Great Britain and Fullerian professor of chemistry and director of the Davy Faraday Research Laboratory; Dr. F. A. Vening Meinesz, professor of geodesy and cartography, the University of Utrecht.

Franklin Medals

FRANKLIN Medals have been awarded by the Franklin Institute, Philadelphia, Pa., as follows: Edwin Hubble, Mount Wilson Observatory, Carnegie Institution of Washington, Pasadena, "In recognition of his extensive study of the nebulæ, particularly those outside our galaxy, as a result of which the dimensions of observed space have been greatly increased"; Albert Sauveur (posthumously), professor emeritus of metallurgy and metallography, Harvard University, "In recognition of his outstanding work in the science of metallography and of his many contributions to this branch of metallurgy which have been in a large measure responsible for changing the heat treatment of steel from an art to a science".

Rare Frankliniana

VISITORS to the recent exhibition of "Frankliniana" at New York City's Grolier Club (March 16–April 16) were impressed alike by the incomprehensible versatility of Benjamin Franklin's genius and by the fascinating rarity of many of the exhibits displayed. Printer, journalist, statesman, advocate of inoculation, inventor, and the most widely travelled American of his day, Franklin crossed the Atlantic Ocean eight times. That he was not unaware of the perils of travel is revealed by an obsolete will "written by my own hand while waiting for a passage to England" in 1757. By his classic kite experiment in 1748 he proved the identity of lightning and electricity, and his book "Experiments and Observations on Electricity", London, 1751, with a preface by his physician and friend Dr. John Fothergill, carried his fame over the civilized world. "Some Account of the Pennsylvania Hospital", Philadelphia, 1754, recalls that Franklin was instrumental in founding what is regarded as the oldest hospital, in the modern sense of the term, in the present United States. He served as the first clerk to the board of management and later as president. "Proposals for Promoting useful Knowledge among the British Plantations", 1743, is believed to be the earliest suggestion in printed form for an American Philosophical Society, to which the author offers his services as secretary. The pamphlet shown is described as one of two copies known. His first book, "Dissertation on Liberty and Necessity, Pleasure and Pain", London, 1725, the young Franklin grew to dislike so violently that he destroyed all remaining copies except one. Other exhibits included a selection of his famous almanacs, so rare to-day, though originally issued in editions of 10,000 copies.

Chaston Chapman Gift to the University of Leeds

IN 1933 Mrs. Chaston Chapman presented to the University of Leeds her late husband's extensive working library of modern books on chemistry, together with complete runs of a large number of periodicals. Mrs. Chaston Chapman has now presented his collection of works on alchemy to the University of Leeds, where they are housed in the Brotherton Library. There is a small section of French books and a more extensive section of

English books. Noteworthy among the latter are "The Mirror of Alchimy, Composed by the thrice-famous and learned Fryer, Roger Bachon", London, 1597; the rare "Secrets Reveal'd: or, An open entrance to the Shut-Palace of the King: Containing The greatest Treasure in Chymistry, Never yet so plainly Discovered", 1669; Plat, "The Jewel House of Art and Nature", 1653; and many other rare works. Translations into English include Geber, "The Works of Geber, the most famous Arabian prince and philosopher", 1678; Beguin, "Tyrocinium Chymicum", 1669; Paracelsus, "The Chymical Transmutation of Metals", 1657; Glauber, "The Golden Ass Well Managed", 1670; Gesner, "The newe Iewell of Health", 1576; Le Febure, "A compleat Body of Chymistry", 1670; the 1677 and 1686 translations of Lemery, "A Course of Chymistry" and "New Curiosities in Art and Nature", 1711, by the same author.

Of large folios from the Chaston Chapman collection there are good copies of the works of Agricola, Cardanus, Josephus, Lucretius, Manget, Paracelsus, Pettus, Petronius, Sennert, van Helmont, and others. There are some two hundred works by German and Dutch seventeenth-century authors. Becher and Stahl, the two founders of the phlogiston theory, are well represented. There are also certain editions of the strange work "De Secretis", composed by Alexis of Piedmont, a contrite revelation to the world of the secret remedies that might have saved a patient's life. Special attention was also paid by Mr. Chaston Chapman to Black, Boerhaave, Boyle, Newton, and Priestley, and there is an interesting series of old and modern books on brewing and fermentation, commencing with "A Perfite platforme of a Hoppe Garden", 1578. A whole case is devoted to the Royal Society, with the first, second, and fourth editions of Sprat's history of the Society. With the single exception of Lord Brotherton's books, this carefully selected library is the most valuable collection of rare books that the University has ever received.

Bledisloe Medal for Native Agriculture

In the recently issued report of the Rhodesia–Nyasaland Royal Commission (see NATURE, May 20, p. 829) stress is laid by members of the Commission in the expression of their individual views regarding certain matters, on the importance of the development of the native for the future of all three territories alike. In this development, agriculture and native husbandry are assigned the foremost place, more especially in the two protectorates, of which the future prosperity can only be based upon agriculture. In the memorandum appended by the chairman, Lord Bledisloe, and Mr. P. A. Cooper, it is said that "Education is a crying need of the African, but its foundation should, in his case, be knowledge of the land and its proper treatment on the one hand and of the basic principles of nutrition and hygiene on the other. These lessons are even more vital to his true welfare than reading and arithmetic, and should take precedence of them." They go on to point out that they are inclined to the view that both land and labour are at present wasted, adding a caution against dogmatic pronouncement that large areas of territory are permanently unsuited to human occupation or economic utilization. In order to encourage the development of the native as agriculturist, Lord Bledisloe has now instituted a silver medal for presentation annually in appropriate numbers to the chiefs of the various tribes of Southern Rhodesia who have done most to induce their tribesmen to adopt improved methods of husbandry. The medal bears on its obverse the figure of a native Afrikander bull with the inscription "Southern Rhodesia Mutungamiri Umtungameli", the Bantu and Sindabele terms for leader or guide. The reverse bears an ear of maize and the inscription "The Bledisloe Medal for the Advancement of Native Husbandry".

Treasure at Delphi

A DISCOVERY, which would seem to be remarkable even in the annals of Mediterranean archæology for the quantity of objects of gold brought to light, is reported from Delphi, where excavations have been in progress under Prof. Delacotte on behalf of the French School of Archæology at Athens during the past two years. A dispatch from the correspondent of *The Times* in the issue of May 10 states that in the course of raising and relaying the pavement of the Sacred Way from the eastern side of the Sanctuary in the direction of the Temple of Apollo in a search for inscriptions, a cavity has been found in the centre of the Stoa of the Athenians, in which was a mass of objects, covered with dust and ashes, and including a large number of gold articles. Of these the most important is the gold overlay of a chryselephantine statue, of which the ivory has been carbonized. The robe, diadem, ear-rings, bracelets, curls, heads and flowers, which formed the decorations of the robe, and the girdle, all in gold, have been recovered. A bronze statuette holding a receptacle for the burning of aromatic woods, which is complete and of remarkable workmanship, is dated at 500 B.C. In addition, there is a quantity of material in clay, copper and bronze. Expert opinion at present is that the finds show evidence of Oriental influence, possibly originating from the Greek cities of Asia Minor. A further discovery is a second cavity, found in working in a northerly direction from the Sacred Way, which was full of bronze and copper objects, all much encrusted, but otherwise in good preservation. Here also Eastern influence is discerned.

Television and the Provinces

MR. C. O. STANLEY, chairman of the Television Development Committee of the Radio Manufacturers Association, spoke at Manchester on May 13 outlining the great progress recently made with television. He pointed out that it is necessary to have a universal service for the whole of Great Britain in order to enable manufacturers to develop the export industry. The first step is to extend television to the provinces. While the mentality produced by experimental tele-

vision remains, the public will not purchase sets. Even if only one provincial station were started, it would show that television has been accepted and would give a tremendous stimulus to the industry. The United States has studied the possibilities of television and by next September there will be twenty stations in operation. If good progress had been made in Great Britain in providing provincial stations and services, manufacturers in this country could have produced sets in such quantities that the initiative could have been taken in the South American countries, in South Africa and in other places. Unless the rate at which we are now moving is accelerated, the stations to be provided in these places will be American stations, and if this were so, the sets now being produced in Great Britain would not work when connected to them.

Changes in Bird Population

IN a civilized country, where social changes are rapid and often extensive, the wild population, whether of birds or other creatures, is undergoing constant readjustment. Much of the change passes unnoticed, and much, even if it be observed by local residents interested in natural history, goes unrecorded. The Royal Society for the Protection of Birds is doing good work in stimulating interest in the changing phases of bird population by offering the Medal of the Society and money prizes for the best paper on "Changes in the bird population of Britain during the present century, in a district or districts known to the writer, in regard to the increase or decrease of species named, what cause or causes can be assigned, and what (if any) effect has been observed". The causes which suggest themselves to the Society include—the universal use of the motor-car and the popularity of 'rambling', opening up hitherto secluded places; afforestation; road development; the disappearance of hedges; the invasion of the open country by factories; the replacement of open ditches by underground drains. There is also deliberate encouragement of birds to be reckoned with, by the creation of bird sanctuaries, the influence of the law's protection, and the altered outlook of the people towards the amenity of bird life generally. The competition should prove to be interesting and useful, although it is obvious that great care will have to be taken in sifting and adjudicating upon the causes alleged to be responsible for any change. The competition is referred to in the spring number (1939) of *Bird Notes and News*.

The National Physical Laboratory

THE report of the Laboratory for the year 1938 is a royal octavo pamphlet of 147 pages published by H.M. Stationery Office at 2*s*. 6*d*. The general report of the Executive Committee occupies 14 pages and is followed by reports of the superintendents of the separate Departments of Physics, Electricity, Radio, Metrology, Engineering, Metallurgy, Aerodynamics and Ship Propulsion, which enter into more detail, extending to 114 pages, and each concludes with a list of papers published by the Department during the year. They seem remarkably free from obscure technical expressions and can in consequence be read with ease by the general public. The changes of staff have been more important than usual. Three directors have been in charge during the year and one superintendent has become director of research in another Government department, while industry and Government departments have absorbed other members of the staff. Lectures on the work of the Laboratory have again been given in large industrial centres (17), and as usual a large number of requests for scientific information on points arising in industrial work have been answered by the Laboratory without charge.

Utilizing Sunshine

DR. C. G. ABBOT, the secretary of the Smithsonian Institution, has published a description of recent devices he has used in converting sunshine into power (*Smithsonian Misc. Coll.*, **98**, No. 5; March 30, 1939). In general, the sun's rays are focused by a cylindrical mirror on to an axial glass tube through which, for the distillation of water or the generation of steam, water flows, and for cooking purposes a black liquid of boiling point above 350° C. The mirror is now made of flexible sheet known as 'Aloa' and the axial tube is surrounded by a concentric vacuum tube. While coal is cheap, Dr. Abbot does not expect extensive use of such devices, but under favourable conditions small units up to five horse-power with an efficiency of conversion of solar to mechanical energy of the order of 15 per cent and a cost of a farthing per horse-power hour may be possible. At present the initial cost of the apparatus is high, but when thousands are required prices will fall.

Books on International Relations

A "SHORT List of Books on International Relations" recommended by the Education Committee of the League of Nations Union (15, Grosvenor Crescent, S.W.1) includes 141 titles arranged in two lists, the first consisting of books for boys and girls and the second of books for students and teachers. The latter is arranged in six sections dealing with the League of Nations, with education, with international relations, with special problems, with collective security and peaceful change and with colonies and raw materials, respectively. The majority of the books are of the descriptive type, but a number of constructive critical works are included, mostly from rather a Left Wing point of view. In addition, the list gives the titles of a number of songs and celebrations as well as of maps and periodicals, and forms on the whole a useful introduction to the study of international relations.

A Mosquito Invasion of South America

THE possibility of the introduction of a disease into a country at present free from it by air-transport of the infected insect-vector has long been recognized, for example, yellow fever by its infected mosquito-carrier. That this menace is real and not hypothetical

is demonstrated by the fact that an African species of malaria-carrying mosquito, *Anopheles gambiæ*, has become established in South America. According to Science Service, this mosquito has been found at Natal, Brazil, and in localities two hundred miles west and north of Natal, and has already caused severe outbreaks of malaria. This mosquito was probably introduced as a stowaway on one of the aeroplanes of the French airline between Dakar in West Africa and Natal in Brazil.

Cadmium Pigments

WE have received from Messrs. Johnson and Matthey, Hatton Garden, London, E.C.1, a copy of a booklet on cadmium pigments. These have cadmium sulphide as a basis, and the sulphide itself can be obtained in any colour from pale yellow to orange. Redder shades are obtained by the incorporation of selenium, so that it is possible to get a complete range from pale yellow, through orange and red, to deep maroon. Cadmium lithopones are also available. The properties of the pigments are described.

High Vacuum Distillation

THE *Transactions of the Society of Chemical Industry* (58, No. 2; 1939) contain several papers presented last November to a meeting of the Chemical Engineering Group which dealt with the industrial applications of high-vacuum distillation. Pressures of the order of 10^{-4} mm. are concerned and the technical apparatus is described with drawings. One important application of the technique is to the concentration of vitamins from oils.

Earthquake in Solomon Islands of April 30, 1939

FURTHER news has come to hand concerning this shock. According to the Bureau central seismologique de Strasbourg, from reports received from thirty seismological stations the epicentre of the most severe shock was at 7·5° S., 159·6° E., depth of focus probably 100 km. and starting time 2h. 55m. 35s. G.C.T. According to reports from the islands, the shock and after-shocks lasted for several days. One of the islands most seriously affected was Guadalcanar, where a number of buildings were wrecked, and where a wave following the shock swamped a number of native villages. On Ysabel Island houses were damaged, and in the Cape Marsh district of the Russell Islands wharves and houses were wrecked. In the island of Savo, surface faults were visible, but there was no loss of life. Altogether nine children and three adults of the indigenous population were drowned.

Earthquake near Japan

USING reports from the seismological stations at Honolulu, Victoria, Tucson, Manila, Huancayo, Zikawei, Burlington and Philadelphia, the United States Coast and Geodetic Survey has made a preliminary determination of the epicentre and initial time as follows: lat. 37° N., long. 142° E., November 30, 2 h. 29 m. 52 s. G.C.T. The epicentre is under the ocean bed to the north-east of the coast of the main island of Japan, and is the same as that for the earthquake of November 22, 1h. 14·1m. G.C.T. No effects of this shock have been reported from land.

Commonwealth Fund Fellowships Awards

THE Committee of Award of the Commonwealth Fund fellowships has made the following appointments, among others, to fellowships tenable by British graduates in American universities for the two years beginning September 1939: C. A. U. Craven, Imperial College of Science and Technology, University of London, to Harvard University, in geology; Dr. B. M. Crowther, Clare College, Cambridge, to the Massachusetts Institute of Technology, in physics; G. M. Henderson, University of Edinburgh, to Princeton University, in chemistry; P. B. Hunt, Christ Church, Oxford, to Columbia University, in economics; G. O. Jones, Emmanuel College, Cambridge, to the Massachusetts Institute of Technology, in engineering; J. P. Keane, University of Wales and University of London, to the University of Michigan, in economics; Edward Lee, University of Manchester, and University of Cambridge, to the University of Michigan, in physics; Nicholas Miller, Imperial College of Science and Technology, University of London, to the University of California, in engineering; D. G. Northcott, St. John's College, Cambridge, to Princeton University, in mathematics; G. W. Parnell, University of Bristol, to the University of California, in zoology; J. H. Read, University of St. Andrews, and Emmanuel College, Cambridge, to Columbia University and the American Film Center, New York, in cinematography; J. A. Scott, Trinity College, Oxford, to the University of Pennsylvania, in economics; Dr. E. V. Watson, University of Edinburgh, to Harvard University, in botany; E. R. Winton, University of St. Andrews, to the Massachusetts Institute of Technology, in engineering; N. A. Wylie, Oriel College, Oxford, to Yale University, in forestry.

THE following have been appointed to fellowships tenable by candidates from the British Dominions: H. C. Corben, University of Melbourne, and Trinity College, Cambridge, to the University of California, in physics; Dr. A. P. Guinand, University of Adelaide, New College, Oxford, to Princeton University, in mathematics. The following have been appointed to fellowships tenable by candidates holding appointments in Government service overseas: H. L. Hume, University of New Zealand, of the Public Works Department, Government of New Zealand, to the University of California, in engineering; M. R. Jacobs, University of Adelaide, and St. Catherine's Society, Oxford, of the Department of the Interior, Government of Australia, to Yale University, in forestry; C. S. Kelly, Balliol College, Oxford, of the Indian Civil Service, Government of Burma, to Yale University, in anthropology; S. L. Macindoe, University of Sydney, of the Department of Agriculture, Government of New South Wales, to the University of Minnesota, in agriculture. The following have been appointed to fellowships tenable

by candidates holding appointments in the Home Civil Service: J. G. M. Allcock, Jesus College, Cambridge, of the Board of Education; C. H. W. Murphy, Selwyn College, Cambridge, of the Unemployment Assistance Board; J. B. Williams, McGill University, and University of Cambridge, of the Colonial Office.

The Night Sky in June

THE short nights round about the summer solstice on June 22 are less than 7½ hours in length according to the sun's setting and rising in the latitude of London, and a little more than 3 hours if nautical twilight be reckoned. The moon is full on June 2 and new on June 17. A notable occultation occurring on June 25 is that of the first magnitude star Spica (α Virginis) when the moon is 8·2 days old. At Greenwich the disappearance takes place at 16h. 12·6m. at position angle 142° from the north point and the reappearance at 17h. 14·0m. at 265°. At Edinburgh, the corresponding times and position angles are 16h. 11·3m. (133°) and 17h. 14·5m. (272°). Lunar conjunctions with the planets take place as follows: on June 6 with Mars, on June 11 with Jupiter, on June 13 with Saturn, on June 15 with Venus. In the latter part of the month, Mercury may be seen in the evening twilight, low down in the direction north of west. Venus rises in the dawn, preceded by Saturn some two hours earlier. Mars is growing brighter (− 1·2 m. to − 2·0 m.) and rises before midnight. Jupiter, also increasing in brightness (− 1·8 m. to − 2·0 m.), rises after midnight. There are close groupings of the four inner satellites about Jupiter at 2½h. on June 5, 22 and 30. On June 17 at the same hour only two of the satellites (3rd and 4th) are visible, the first two being in transit. At the beginning of June the faint comet Pons-Winnecke is near β Boötis and by mid-June near β Coronæ Borealis. Comet Jurlof-Ackmarof-Hassel is being lost in the sunset. On June 1 it will be about 5° north of γ Geminorum, and by June 30 about midway between Procyon (α Canis Minoris) and γ Geminorum. In mid-June at 22h., Arcturus has already southed; Antares, low down in the south, is approaching meridian passage; Vega is 3 hours before the meridian. The small beautiful constellation Corona Borealis is on the meridian. At midnight, 24h. U.T. (all times being thus expressed: add 1h. to convert to Summer Time), the star γ Draconis passes within 1¼′ of the zenith at Greenwich. Observation of this star in 1725–26, for any sign of annual parallax, led to the discoveries by Bradley of the aberration of light and, later, of the nutation of the earth's axis.

Announcements

PROF. EMMANUEL TEODORESCO, of the University of Bucharest, has been elected *correspondant* of the Section of Botany of the Paris Academy of Sciences.

THE two lectures which were to have been delivered by Dr. A. Hrdlička at University College, London, in April but which were postponed, will be delivered on May 31 and June 1 at 5 p.m. The subject of the first lecture will be "The Present Status of our Views on Human Evolution", and that of the second "The Racial Fallacies and Realities of European Peoples". The lectures are open to the public.

THE Gresham lectures on astronomy will be delivered on May 30, 31, June 1 and 2 at Gresham College, Basinghall Street, E.C.2, at 6 p.m. by Mr. Arthur R. Hinks. The subject of the course is "Recent Discoveries of Special Interest". The lectures are open to the public.

AT the anniversary meeting of the Linnean Society of London held on May 24, the following officers were elected for the year 1939–40: *President*, Dr. John Ramsbottom; *Treasurer*, Mr. Francis Druce; *Secretaries*, Mr. Isaac H. Burkill (botany) and Dr. Malcolm A. Smith (zoology); *New Members of Council*, Prof. T. M. Harris, Mr. H. R. Hewer, Prof. T. G. B. Osborn, Mr. H. W. Parker and Dr. Malcolm A. Smith.

AT the annual general meeting of the Institute of Physics held on May 17, the following were elected to take office on October 1, 1939: *President*, Prof. W. L. Bragg; *Vice-President*, Prof. A. Ferguson; *Honorary Treasurer*, Major C. E. S. Phillips; *Honorary Secretary*, Prof. J. A. Crowther; *New Members of the Board*, Dr. H. Lowery and Mr. R. S. Whipple; and Mr. J. H. Awbery (appointed by the Physical Society).

THE Medical Research Council has appointed the following committee to advise and assist in promoting investigations into problems of preventive medicine: Sir W. Wilson Jameson, dean of the London School of Hygiene and Tropical Medicine (chairman); J. H. Brincker; J. Fenton; J. Ferguson; W. M. Frazer; L. H. R. Harries; A. Bradford Hill; W. D. Hood; J. R. Hutchinson; R. A. McCance; A. S. M. MacGregor; R. H. Parry; Prof. R. M. F. Picken; W. M. Scott; J. C. Spence; Prof. W. W. C. Topley; D. K. M. Chalmers, of the National Institute for Medical Research (secretary).

THE thirtieth annual Conference of the Association of Teachers in Technical Institutions will be held at Southport during May 27–30, under the presidency of Dr. E. A. Seeley of the Municipal College, Bournemouth. Further information can be obtained from the Secretary at 29 Gordon Square, London, W.C.1.

UNDER the auspices of the French Zoological Society, the thirteenth International Congress of Zoology will be held in Paris in July 1940, the actual date not having so far been fixed. Further information can be obtained from the Secretary-General, Société Zoologique de France, Institut Océanographique, 195 rue St.-Jacques, Paris, V^e^.

THE bicentenary of the foundation of the Royal Academy of Sciences of Sweden will be celebrated on September 23–25.

ERRATUM. In NATURE of May 20, p. 844, column 1, under "Prominences through Colour Filters" and under "Movements of Prominences", "for $H\lambda$" read "$H\alpha$".

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 901.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Reflection of Atmospherics from the Ionosphere

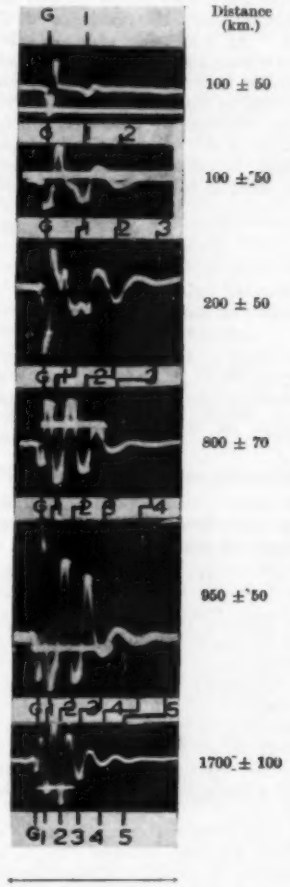
THE details of the structure of the 'oscillatory' portion of the wave-form of an atmospheric have been the subject of several investigations[1]. Prof. T. H. Laby and his co-workers of the Australian Radio Research Board have made the remarkable suggestion that the observed complicated structure can be interpreted in terms of a series of reflections from an ionospheric layer of the simpler primary disturbance due to lightning. Their analysis places this height at 59–88 km.

We have worked on this question since November 1937 in conjunction with a direction-finding network which fixes independently the distance from receiver to parent thunderstorm, and arrangements have been used whereby the wave-form oscillogram corresponding to a source at a known distance is automatically marked. The height of the layer is then the only unknown quantity to be determined from the wave-form record. Several thousand oscillograms of atmospherics which have travelled from 50 km. to 2,800 km. have been examined.

A study of these records strongly supports the view of the Australian workers that the structure arises from repeated reflections, but brings to light a new feature which can be interpreted as a pronounced lowering of the effective height of the layer, h, in the neighbourhood of the parent storm. Thus we find: (1) h determined from the singly reflected sky wave is equal to 85 $\pm$ 5 km. for all direct distances between 2,800 km. and 600 km., that is, at all points of reflection from 1,400 km. to 300 km. from the source. (2) h determined from multiply-reflected sky waves is also equal to 85 $\pm$ 5 km. provided that no component reflection takes place within a distance less than 300 km. from the source. (3) For cases where reflection occurs one or more times within this critical distance of 300 km., h falls from 85 km. at 300 km. distance to 50 km. directly above the source. By examining the multiple reflections at one distance only, a model of the layer can be constructed which satisfactorily accounts for all reflections at all distances examined

This evidence indicates that there is a real lowering of the effective height of reflection for long waves in the neighbourhood of a thunderstorm. Evidence for abnormal ionization of the layer under these conditions has already been found by many workers on short-wave pulse-sounding

The accompanying reproduction illustrates how the first pulse of the ground-wave G is related in time and amplitude to the corresponding sky waves 1, 2, 3, 4, 5 after the atmospheric has travelled various distances. At small distances (A, B) the reflected waves are separated from the ground-wave (a single complete period of disturbance) by a quiet interval. Farther away (C to F) they form an apparently continuous damped oscillation. It can



WAVE FORMS OF ATMOSPHERICS. G, FIRST PULSE OF GROUND WAVE; 1, 2, 3, 4, 5, CORRESPONDING PULSES REFLECTED 1, 2, 3, 4, 5 TIMES BY LAYER.

be shown that this continuity is due to an effective increase in 'wave-length' of a single long-period transient on reflection, and arises if the properties of the layer vary appreciably over a distance of the order of a wave-length. The reproduction illustrates how the time-interval between successive reflections decreases with distance and can be used for the conclusions listed under (1), (2) and (3) above. In deriving h from these results, it is necessary to consider the curvature of the earth and the layer.

The relative amplitudes of the first ground-pulse G and its reflections 1, 2, 3, 4 and 5 alter noticeably with distance. At moderate distances, as would be expected, G is the largest (A,B,C). Farther out (D,E), attenuation of the ground-wave reduces its amplitude below that of the first sky wave. Still farther away from the parent storm (F) the first sky wave must graze the earth before reaching the receiver and becomes attenuated from this cause also, so that the second sky wave has the maximum amplitude.

The atmospherics which exhibit the clear evidence of reflection here discussed are all due to flashes to ground. As has been pointed out elsewhere, discharges within the thundercloud produce effects which are weaker in intensity and more complex in form.

We have to thank Mr. I. Katz, Prof. D. B. Hodges and Mr. Phillips of Howard College, Durban, and Mr. R. A. Jubb of the Meteorological Department, Southern Rhodesia, for operating the direction-finders used in locating thunderstorms.

B. F. J. SCHONLAND.
J. S. ELDER.
J. W. VAN WYK.
G. A. CRUICKSHANK.

Bernard Price Institute,
University of the Witwatersrand,
Johannesburg.

[1] Watson Watt, R. A., Herd, F. F., and Lutkin, F. E., *Proc. Roy. Soc.*, A, **162**, 267 (1937). Appleton, E. V., and Chapman, F. W., *Proc. Roy. Soc.*, A, **158**, 1 (1937). Laby, T. H., Nicholls, F. G., Nickson, A., and Webster, H., NATURE, **139**, 837 (1937). Laby, T. H., Nicholls, F. G., Nickson, A. F. B., and McNeill, J. J., NATURE, **142**, 353 (1938).

Disintegration of Nitrogen by Fast Neutrons

ACCORDING to researches published up to the present time, bombarding nitrogen with fast neutrons produces the two following nuclear reactions:

(i) $^{14}N + {}^{1}n = {}^{11}B + {}^{4}He$
(ii) $^{14}N + {}^{1}n = {}^{14}C + {}^{1}H.$

The present paper deals with the determination of the cross-sections σ for these two processes and the total energy Q evolved in reaction (i).

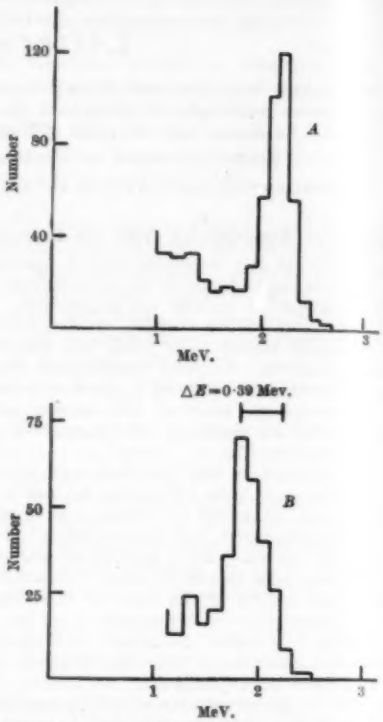
An ionization chamber filled with nitrogen was bombarded with fast neutrons obtained by the reaction $^{2}D(^{2}D,{}^{1}n)^{3}He$. The products of transformation were detected with the help of a linear amplifier and of an oscillograph. Both neutron source and amplifier have been described in detail in a former paper[1].

In the accompanying figures are plotted two statistics for the process $^{14}N(^{1}n,{}^{4}\alpha)^{11}B$. Curve A corresponds to an angle of observation of 0° (neutronic energy 2·8 Mev.) and Curve B to an angle of 90° (neutronic energy 2·36 Mev.). By 'angle of observation' we understand the angle between the direction of the incident deuterons and the direction of observation of the emitted neutrons. The cross-section σ and the reaction energy Q for the process $^{14}N(^{1}n,{}^{4}\alpha)^{11}B$ can be determined, since the intensity of the neutron source and the energy of the emitted neutrons are known. The study of a thousand of such processes gave the following results:

$$\sigma = 1{\cdot}63 \times 10^{-25} \text{ cm.}^2. \quad Q = -0{\cdot}43 \text{ Mev.}$$

From corresponding measurements for the process $^{14}N(^{1}n,{}^{1}H)^{14}C$ we found a cross-section equal to $\sigma = 0{\cdot}4 \times 10^{-25}$ cm.^{2}.

The difference between the neutronic energies corresponding to the two angles 0° and 90° can be calculated by means of the theorems of conservation of energy and momentum. If the deuterons are accelerated by 140 kv., this energy difference is equal to 0·44 Mev. The observed difference, 0·39 Mev., is, within the limits of possible errors, in agreement with the calculated value.



OSCILLOGRAPH DEFLECTIONS AS A FUNCTION OF THE CORRESPONDING ENERGY

A complete account of the experiments will be published in the *Helv. phys. Acta*.

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P. HUBER.

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April 1.

[1] Baldinger, Huber and Staub, *Helv. phys. Acta*, **11**, 245 (1938).

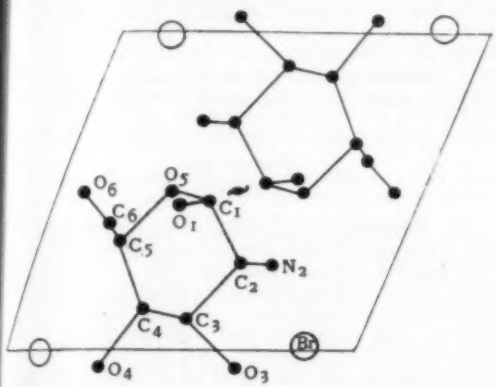
Crystal Structure of Glucosamine Hydrobromide

PROGRESS in the detailed analysis of carbohydrate crystal structures has hitherto been slow, on account of the lack of guidance from physical (optical and magnetic) properties of the crystals, the wide choice of molecular conformations on which 'trial and error' calculations might be based, the absence of outstandingly strong reflection intensities, and the asymmetry of the compounds concerned. The isomorphism of α-chitosamine hydrochloride and hydrobromide has now enabled us to determine the positions of all the atoms (other than hydrogen) in the crystal lattices of these substances by synthetic methods alone, no stereochemical assumptions being necessary.

α-Chitosamine hydrobromide and hydrochloride are monoclinic sphenoidal, space-group $P2_1$, with two molecules in the unit cell, the dimensions of which are as follows :

Hydrochloride[1]	Hydrobromide
a = 7·68 A.	a = 7·96 A.
b = 9·18	b = 9·29
c = 7·11	c = 7·18
β = 112° 29′	β = 112° 35′

About 900 reflection intensities (Cu radiation) were measured for each salt, and the structure amplitudes derived from them were employed in three-dimensional Patterson (F^2) syntheses, and two- and three-dimensional Bragg (F) syntheses. The phase angles necessary for the latter were obtained by comparison of corresponding F-values for chloride and bromide. In this way we have arrived at the structure which is shown projected on the (010) plane in the diagram



and more precisely described by the accompanying table of atomic co-ordinates ; these are accurate to about 0·01, that is, about 0·08 A., with the exception of those for the primary alcohol oxygen atom, the position of which has not emerged quite so definitely from the Fourier syntheses, possibly because it is oscillating over an appreciable angle, as appears not improbable from its environment in the lattice. There is no doubt, however, that this atom is attached to the sixth carbon atom. The general accuracy of the analysis is vouched for by the fact that in the numerous F-syntheses performed, there occur no negative electron densities comparable in magnitude with the positive values in the atomic peaks.

Atom	x	y	z	Atom	x	y	z
Br	0·142	0	0·018	O_1	0·65	0·50	0·48
C_1	0·56	0·35	0·47	N_2	0·32	0·47	0·27
C_2	0·41	0·33	0·27	O_3	0·30	0·30	−0·06
C_3	0·49	0·33	0·10	O_4	0·67	0·17	−0·05
C_4	0·62	0·20	0·13	O_5	0·68	0·24	0·50
C_5	0·76	0·20	0·35	O_6	~0·91	~0·02	~0·50
C_6	0·81	0·04	0·40				

We are now engaged in refining this structure by utilizing structure amplitudes the phase angles of which were originally uncertain, together with others obtained with molybdenum radiation, and also by 'trial and error' methods. Meanwhile, it may be of interest to point out that the accuracy of the analysis as it stands is adequate, *without the assistance of any stereochemical data*, to justify the following statements :

(*a*) For the first time the configuration of a carbon compound containing several asymmetric centres has been confirmed by direct determination of atomic positions. In this particular case, chitosamine is shown to be a derivative of glucose and not of mannose (cf. the recent work of Haworth, Lake and Peat[2]).

(*b*) The pyranose (six atom) ring has a real existence in a crystalline sugar. (It should be observed that the chemical evidence for pyranose structures applies strictly to glucosides and only by inference to sugars.)

(*c*) In the α-form of a *d*-glucose derivative (that is, that which possesses the higher [positive] rotation) the oxygen atoms on the first and second carbon atoms are in *cis* positions.

The analysis is not yet sufficiently refined to distinguish between a nitrogen and an oxygen atom, so that we cannot at present confirm that in chitosamine the nitrogen atom is attached to the second carbon atom ; this, however, is completely certain from its mode of synthesis. The pyranose ring is definitely not Sachse *cis* (boat-shaped), but is either Sachse *trans* or some partially flattened form of it[3].

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Edgbaston,
Birmingham, 15.
March 29.

[1] Cox, E. G., and Goodwin, T. H., *Z. Krist.*, **85**, 462 (1933).
[2] *J. Chem. Soc.*, 271 (1939).
[3] cf. Cox, E. G., Goodwin, T. H., and Wagstaff, A. I., *J. Chem. Soc.*, 1495 (1935).

Absorption Spectra of Proteins

In a recent communication[1], Prof. F. Haurowitz and Dr. T. Astrup describe observations of absorption spectra on solutions of native and digested serum globulin, which are said to be in better accord with the classical theory of the structure of proteins than with the cyclol hypothesis. They reason that because, after digestion of serum globulin with trypsin to a stage at which only a fine opalescence is given with sulphosalicylic acid, there is no increased absorption at λ 240 mμ, there has therefore been no formation of CO groups from >C(OH) − N< groups which are required by the cyclol hypothesis.

Haurowitz and Astrup state that CO groups absorb strongly at λ 240 mμ. This is contrary to observations made here and elsewhere on amino-acids and peptides. For example, at this wave-length the molecular extinction coefficient of glycyl-leucine is only 10. At λ 240 mμ the contribution of CO groups to the absorption of serum globulin is small compared with that of the nuclei of the aromatic amino-acids. The former can be calculated from average amino-acid composition figures for serum globulin and known extinction coefficient values for the aromatic amino-acids at λ 240 mμ to be about 17 per cent of the total.

The change of absorption of the globulin on digestion can be seen to be mainly a shift of the whole band to shorter wave-lengths with a filling up of the trough. That this shift is due to change in absorption of tyrosine and tryptophane has been shown in experiments to be published. This shift in itself causes a fall in absorption at λ 240 mμ large enough to mask a large increase of the kind for which Haurowitz and Astrup were looking. It would be

necessary to distinguish change of absorption of the aromatic amino-acids from appearance of new absorbing centres (CO groups) before such observations could be used as arguments for or against the cyclol hypothesis.

The question will be discussed more fully in a paper to be published shortly.

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[1] Haurowitz and Astrup, NATURE, 143, 119 (1939).

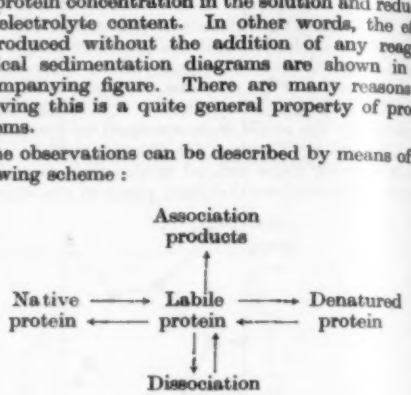
Protein Stability as Revealed by Ultracentrifugal Analysis

IN the course of sedimentation velocity studies with serum protein mixtures, it has been noted from time to time that the concentrations of the different molecules calculated from the sedimentation diagram differ from those determined analytically[1]. The substance sedimenting at the higher rate decreases in amount to form units of a lower apparent sedimentation constant, even though it has appeared to be perfectly stable under the same conditions when it is present alone. It has been concluded that these changes are caused by some medium effect produced by the action of one protein upon the other. It was then reasoned that it should be possible to produce this effect by means of such lower molecular substances as amides, amino-acids, polypeptides, and protamines. The action of such 'dissociating compounds' is found to be highly specific. Thus an amino-acid which acts strongly upon a certain protein may have no effect upon another, and *vice versa*, and the effect may depend upon the presence or absence of salt[2,3].

Naturally it is important to understand such effects of proteins upon each other and of smaller molecules upon proteins. In some quarters it is believed the effect is due to a real dissociation of the faster sedimenting unit, but it must be recognized that in some cases the modification of the sedimentation rate may arise from a change in the shape of the molecule or even from hydration effects. It appears that final answer to this question will have to come from the results of parallel osmotic pressure determinations.

It has now been found that changes in sedimentation behaviour of the type mentioned above can be produced, at least in solutions of the uniform proteins now being investigated in this Laboratory (antitoxic (diphtheria) pseudoglobulin, thyroglobulin[4], thymus nucleohistone), by the simple expedient of increasing the protein concentration in the solution and reducing the electrolyte content. In other words, the effect is produced without the addition of any reagent. Typical sedimentation diagrams are shown in the accompanying figure. There are many reasons for believing this is a quite general property of protein systems.

The observations can be described by means of the following scheme:



The formation of the labile state, probably due to an unfolding of native protein, appears not to involve any reaction between molecules, but is essentially a slow, intramolecular change involving an equilibrium, the rate of establishment of which depends upon protein and hydrogen ion concentration of the solution and temperature. An increase in protein concentration and the removal of electrolyte from the solution favour the formation of the labile form. Any subsequent formation of denatured protein, dissociation or association products depends upon the presence of such reagents as urea, salicylate, hydrogen ion concentration of the solution, heat, ultra-violet light, and other factors.

Inasmuch as the presence of certain proteins, amino-acids or other substances favours the establishment of this equilibrium or may cause complete denaturation or change in molecular size even in the presence of salt, we believe this equilibrium between native and labile protein to form the basis of effects noticed by McFarlane, Pedersen, and others.

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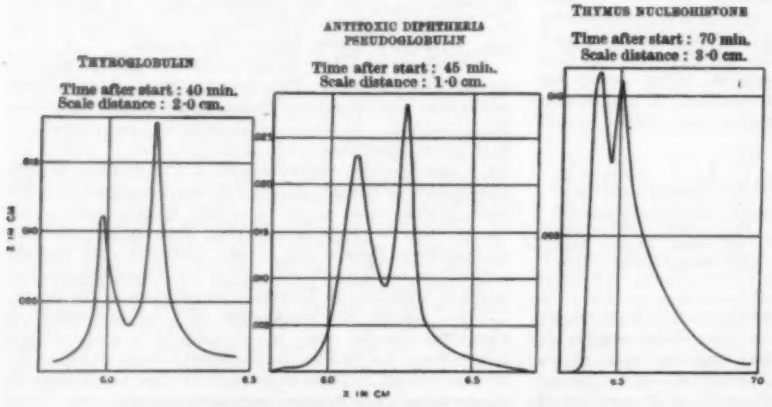
April 4.


THYROGLOBULIN
Time after start : 40 min.
Scale distance : 2·0 cm.
ANTITOXIC DIPHTHERIA PSEUDOGLOBULIN
Time after start : 45 min.
Scale distance : 1·0 cm.
THYMUS NUCLEOHISTONE
Time after start : 70 min.
Scale distance : 3·0 cm.
X IN CM

ULTRACENTRIFUGAL SEDIMENTATION DIAGRAMS.

From left to right in each diagram, labile and native components. Concentration and *p*H for each protein as follows: thyroglobulin, 4·3%, *p*H 6·1; antitoxic diphtheria pseudoglobulin, 5·5%, *p*H 7·6; thymus nucleohistone, 1·2%, *p*H 6·0.

[2] McFarlane, *Biochem. J.*, 29, 407 (1935).
[3] Pedersen, NATURE, 138, 368 (1936).
[4] Svedberg, *Ind. Eng. Chem., Anal. Ed.*, 10, 119 (1938).
[4] Lundgren, *J. Chem. Phys.*, 6, 177 (1938).

X-Rays and the Cyclol Hypothesis

THE purpose of the vector map described by Fankuchen and Riley[1] to which Dr. Wrinch has taken exception in her recent letter[2] was merely to show that the cyclol C_2 skeleton does not contribute anything to the specific character of the observed X-ray reflections from crystalline insulin. No one imagines that insulin contains only (CCN) groups, but these are the only atoms of which the positions have been definitely stated by Dr. Wrinch, and therefore the only ones amenable to exact computation. Dr. Wrinch is, of course, at liberty to place other concentrations of density wherever she likes, but she cannot logically claim in this case that the structure arrived at in this way offers any confirmation of the cyclol hypothesis. Moreover, as has been shown already[3], Dr. Wrinch's construction of the vector map from such concentrations[4] has been incorrectly carried out, and therefore cannot confirm her proposed model of the insulin structure. Finally, the shape and size of the cyclol molecule do not offer a particularly convincing fit into the cell of insulin. Any spherical molecule of approximately the right molecular weight would fit the cell equally well. The only positive agreement is in the presence of a trigonal axis of symmetry, which can scarcely be claimed to justify the acceptance of such an elaborate construction.

We feel, therefore, that no case whatever has been made out for the acceptance of the cyclol model on X-ray grounds; indeed so far as it goes, the X-ray evidence is definitely against the model and in favour of one composed not of a cage but of more or less discrete sub-units, although it is admitted[5] that no model has yet been proposed that will fit existing experimental evidence. The arguments against the cyclol molecule on X-ray grounds have now been fully stated[6], and it seems to us unprofitable to continue the discussion until fresh evidence or new interpretations are provided.

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May 9.

[1] NATURE, **143**, 648 (1939).
[2] NATURE, **143**, 763 (1939).
[3] Bernal, NATURE, **143**, 74 (1939).
[4] Wrinch and Langmuir, *J. Amer. Chem. Soc.*, **60**, 2247 (1938).
[5] Physical Society, discussion of paper of Langmuir, Dec. 20, 1938 (in course of publication).
[6] cf. 1 and 5, Bernal, *Proc. Roy. Soc.*, A, **170**, 75 (1939); Bernal, NATURE, **143**, 663 (1939).

Rapid Calculation of Relative Humidity from Readings of the Sling Hygrometer

AT the recent Institute of Physics Conference at Leeds, I communicated a rule which I have found useful for calculating the relative humidity direct from readings of the ventilated wet- and dry-bulb hygrometer. Expressed so as to facilitate rapid mental calculation, it is as follows: to calculate the percentage relative humidity, express three times the wet-bulb depression (° F.) as a percentage of the dry-bulb reading, and subtract from 100; or symbolically:

$$\text{R.H. } (\%) = 100 - 3\left(\frac{t - t'}{t}\right) \times 100,$$

where t = dry-bulb temperature (° F.)
t' = wet-bulb temperature (° F.).

The same formula applies when centigrade thermometers are used, except that the wet-bulb depression must then be expressed as a percentage of the dry-bulb temperature plus 18.

The rule applies only to the readings of a ventilated hygrometer, and breaks down at relative humidities below 30 per cent; but it applies very closely from 30 to 100 per cent relative humidity, and over an air-temperature range of 20° to 140° F. The degree of accuracy of the formula over these ranges can be checked by comparing calculated values with the corresponding values given in "Psychometric Tables for Obtaining the Vapour Pressure, Relative Humidity, and Temperature of the Dew Point" by C. F. Marvin, U.S. Dept. of Agriculture Weather Bureau, 1937. It will be found that the average difference between the calculated and tabulated values is less than 2 per cent R.H., whilst the maximum difference under extreme conditions within the ranges mentioned is ± 4 per cent R.H. For example, according to the formula, a wet-bulb depression of 5° F. at temperatures of 20°, 40°, 60° and 100° F. corresponds to relative humidities of 25, 63, 75 and 85 per cent respectively, whilst the tabulated values are 26, 60, 73 and 83 per cent R.H.

If the practical interest is confined to the more restricted ranges between 50 and 90 per cent R.H., and 40° F. to 120° F., the calculated relative humidity is in general higher than the tabulated by 2 per cent, and when this correction is made the error does not exceed 1 per cent R.H.

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Rapid Graphical Analysis of Circuit Performance by the Use of Logarithmic Charts

IN connexion with some recent work, use has been made of charts with log (| impedance |) and log (frequency) as axes, and the properties of this plane have been found to lend themselves to graphical use. The chief properties are:

The impedances of the three circuit elements (resistance, capacity and inductance) are represented by straight lines.

The impedance for all frequencies of any two elements in series is exactly represented by one of two curves the shape of which does not depend upon the value of the elements; these can therefore be made in the form of templates.

Since $\log \frac{1}{|Z|} = -\log |Z|$, operations upon impedances in series and parallel are equally simple, and the same two curves apply to elements in parallel as in series.

Since the ratio of the voltage (E_2) across one (Z_2) of two impedances (Z_1, Z_2) in series, to the total voltage E is

$$\frac{|Z_2|}{|Z_1 + Z_2|}$$

and

$$\log \frac{|Z_2|}{|Z_1 + Z_2|} = \log |Z_2| - \log |Z_1 + Z_2|,$$

and the attenuation in decibels is $\left[20 \log_{10} \frac{E_2}{E}\right]$, distances in the vertical direction give attenuations directly.

The use of charts of this plane, together with the two elementary curves mentioned above, enable the rapid graphical analysis of the behaviour of many circuits, also the synthesis of networks with desired frequency characteristics and the determination of equivalent circuits.

An accuracy to 5 per cent in frequency or impedance and 0·5 decibel in attenuation can readily be obtained. The method has been found both rapid and convenient in application to various aspects of radio receiver design.

Acknowledgment is due to Murphy Radio, Ltd., for permission to publish this information.

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Murphy Radio, Ltd.,
Welwyn Garden City,
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March 28.

Structural Geology of the Bermuda Islands

IN conjunction with investigations for the development of a technique for deep-sea seismic measurements that will permit the obtaining of positive geological information on the structure of the ocean basins, we have investigated the structural geology of the Bermuda Islands.

Of especial interest is the fact that contours around the Bermuda area based upon recently published sounding data[1] and unpublished soundings secured by the ketch *Atlantis* of the Woods Hole Oceanographic Institute suggest that the islands consist of four main volcanic cones with several minor ones on the flanks of the main structures, and also that the island mass is surrounded by a series of concentric folds which die out in amplitude with distance from the islands. In order to verify this latter indication, we have arranged for several lines of continuous soundings to be made in the near future.

Two seismic refractions depth profiles made in the island area show the top of the volcanics to lie at depths of 273 feet and 243 feet below sea-level. These determinations are in excellent agreement with the depth reported for the top of the volcanics in a deep well in the islands, 245 feet below sea-level. The volcanics were characterized by a velocity of 16,000 ft./sec., whereas the overlying calcareous eolianite composing the visible portion of the islands had a velocity of 8,800 ft./sec.

An examination of existing magnetic data which comprise a fairly complete isogonic survey[2] and localized studies of the variation in the horizontal component of the earth's field[3] show that the islands are characterized by local areas of low magnetic susceptibility. Further, that the depths of the disturbance are all about the same and less than 1,200 feet in depth. To elaborate the magnetic indications further, we have made a series of observations on the vertical component of the earth's field and find very high local disturbances both positive and negative in character. This work is still too incomplete to permit any conclusions to be reached as to the nature of the disturbances. They are near surface, and it is believed cannot be attributed to artificial causes.

Of significance in this connexion is the discovery of a calcareous sandstone heavily impregnated along dark bands with magnetite, ilmenite and andradite garnet. There are no surface exposures of this rock, and it was brought up from twenty feet below water in constructing a bridge pier. Also believed of significance is a coarse limestone conglomerate cemented in a very dense calcite matrix which occurs at about the same depth in several localities. In this formation we have found a weathered volcanic pebble four inches in diameter, but so far only one.

From the evidence presented it is seen that various conflicting conclusions might be drawn, but it is hoped by extending the seismic measurements, the magnetic studies, and geological studies of the lower dense limestone formation to reach a structural interpretation that will satisfy all the observed conditions. The nature of the exposed surface geology, cross-bedded eolianites, makes orthodox methods of structural geological investigation of little use in this area.

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MAURICE EWING.

Bermuda Biological Station for Research,
St. George's, W.
Bermuda.
April 13.

[1] Admiralty Chart, No. 360 (1938).
[2] Cole, J. F., *Terr. Mag. Atom. Elec.*, **13**, 49 (1908).
[3] Fisk, H. W., Sp. Rpt. 339, Carng. Inst. Wash., pp. 353–357.

Microphonic Potentials from the Utricle

Stevens and Davis[1] have put forward the view that the generation of potential differences in the cochlea when sound is incident on the ear is due to the 'piezoelectric' properties of the hair-cells themselves.

The principal item of evidence for this view is the similarity of the threshold curves for the microphonic effect determined oscillographically in the guinea pig and for sound perception in man. By implication, therefore, the microphonic effect is an integral part of the receptive process. Their argument is supported by the work of Adrian, Craik and Sturdy[2], who have demonstrated microphonic potentials in the ears of lower vertebrates (eel, frog, tortoise), which, though they do not possess a cochlea, yet have hair-cells in the macula of the labyrinth closely resembling those of Corti's organ. These observations were confined to the inferior part of the labyrinth, in particular the sacculus, which in these animals has an auditory function. This evidence therefore tends to confirm the belief that such microphonic potentials might be intimately connected with the reception of sound.

I have obtained similar microphonic potentials from the labyrinth of perch, tench and roach in response both to loud air-borne sounds and to vibrations transmitted through the bench. By exploration with concentric electrodes, it was possible to show that they were derived not only from the sacculus (and perhaps the lagena) but also from the utriculus. Indeed they could be obtained equally well from the latter after complete bilateral extirpation of sacculus and lagena, which in these bony fishes are widely separated from the upper non-auditory part of the labyrinth. Von Frisch[3] has demonstrated that in fish, as in higher vertebrates, the utricle plays no part in hearing. It is clear therefore that the generation of microphonic potentials in a sense organ is not in itself a sufficient

indication of the reception of acoustic or vibratory stimuli. Consequently it is not legitimate to regard the magnitude of the microphonic response as a measure of the sensitivity of an auditory organ.

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April 28.

[1] Stevens and Davis, "Hearing" (New York: Wiley, 1938).
[2] Adrian, Craik and Sturdy, *Proc. Roy Soc.*, B, 125, 435 (1938).
[3] von Frisch, *Biol. Rev.*, 11, 210 (1936).

Microspores in Diatoms

THE occurrence of microspores in centric diatoms and their possible nature have been the objects of great discussion. Recently, Gross[1], on the basis of cultures of *Chætoceros pseudocrinitus* and *Ch. didymus*, concluded that "there is no evidence whatever that these microspore-like bodies found in the cultures of *Ch. pseudocrinitus* acted as reproductive cells. They were never liberated or at any rate never found outside the parental cells, and flagellate-like cells were never found in the cultures where their formation had taken place". He tentatively put forward the view that "what have been described as microspores are either abnormal products of the diatom cell or alien flagellates, neither participating in the life cycle of the diatoms".

Culture work with plankton diatoms has suggested a different conclusion. In cultures of *Chætoceros* species obtained by isolation of single cells or chains by means of capillaries and cultivated according to Allen's method[2], two species formed microspores, namely, *Ch. constrictus* and *Ch. decipiens*. The formation of the spores took place in much the same way: the cell content first divided into two, then into four parts by constrictions parallel to the valves. Each part then divided into two by constrictions perpendicular to the valve, so eight spores were formed in each cell. The spores were not all strictly of the same size; but all contained one or more chromatophores. Being fully developed, the spores had one rather solid cilium, several times as long as the spore, lying coiled around the spore. The liberation of the spores from the cells was observed. They were lively and motile and the culture fluid was crowded with them. Among the free-swimming microspores several were larger than the others and had two cilia. Fusion between two single-ciliate ones was, however, not observed. The formation of microspores took place in cultures without usual signs of crowding.

Transference of *Ch. decipiens* microspores by means of capillaries from a culture to a drop of pasteurized Allen sea-water[2] and again to a flask with the same fluid in such a way that no regular *Chætoceros* cells might by chance be brought along, gave in several cases luxurious cultures of regular *Ch. decipiens* cells. In some cases two microspores or more were transferred, in other cases only one. Growth occurred in some cultures of both categories, but the number of isolations are yet too small to allow any conclusion as to the possible necessity of two microspores for obtaining ordinary vegetative *Chætoceros* cells from microspores.

The development of regular *Chætoceros* cells from microspores seems to give conclusive proof that these spores represent a mode of reproduction in *Chætoceros*. Their part in the life-cycle of the plant has to be determined by further studies, also of the cytological features of microspore formation.

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The University,
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April 21.

[1] Gross, F., "The Life History of some Marine Plankton Diatoms", *Phil. Trans. Roy. Soc.*, B, No. 548 (1937).
[2] Allen, E. J., and Nelson, E. W., "On the Artificial Culture of Marine Plankton Organisms," *J. Mar. Biol. Assoc.*, 8 (1910).

Cultivation of Rabies Virus in the Developing Chick Embryo

IN a recent publication we reported that fixed rabies virus can be recovered from an infected chick embryo, that the virus tends to be localized in the brain of the embryo, but that serial passage was irregular and uncertain[1].

The continuation of these studies has led to successful serial passage of the virus in the developing chick embryo. In one series the virus has been carried through nine, and in a second, through six successive passages without loss of virulence of the virus to mice and rabbits when infected intracerebrally. The virus is present both in the allantois and in the embryo brain, but always in higher concentration in the latter. Both series are being continued.

The successful cultivation of the virus in the developing chick embryo depends, apparently, on the age of the embryo at the time of infection, as well as at the time of passage. A large series of experiments showed that embryos of eight days or more are only irregularly infected and that passages are, as a rule, negative. On the other hand, embryos 5–6 days old are readily infected and serial passages can be maintained without any difficulty if they are made 9–10 days after infection. The eggs have been kept at a temperature range of 37·0–38·5° C.

The following experiments are illustrative of this:

(*a*) Embryos eight days old were infected with 0·1 c.c. of a 1 : 10 emulsion of infected mouse brain; eggs opened nine days later: the embryo brain infected mice injected intracerebrally with a dilution of 1 : 10, the allantois failed to infect; in another case the embryo was removed after twelve days and both brain and allantois infected mice in dilutions of 1 : 100.

(*b*) Embryos five days old were infected as above; embryos removed nine days later, and both brain and allantois were infective for mice in dilutions of 1 : 10,000; embryos removed after thirteen days, the brain was infective in a dilution of 1 : 1,000 and the allantois in a dilution of 1 : 100.

In all passages thus far, the embryo brain removed 9–10 days after the infection was infective for mice in dilutions of 1 : 1,000 to 1 : 10,000. Passages from embryo to embryo can be made with emulsions of either allantois or embryo brain, provided that young embryos are infected and that passages are made not later than 10 days after the infection. Embryos removed more than ten days after infection have shown lower concentration of virus; in one case (passage 4) an embryo tested fifteen days after infection failed to infect mice in any dilution. It is of interest that this specific neuro-virus can be cultivated in the chick embryo provided the infection is made at the earliest possible stage of its development.

The embryo brain of the passage virus of the sixth passage was still virulent for mice when injected intraperitoneally. Studies of the pathogenicity of the virus for chick embryos and on the virulence and immunizing properties of later passages of the embryo culture virus for mammals are being continued.

This work has been assisted by a grant from the Ella Sachs Plotz Foundation.

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Kligler, I. J., and Bernkopf, H., *Proc. Soc. Exp. Biol. and Med.*, **39**, 212.

Œstrous Cycle in the Cat

THE problem of reproduction among cats was studied so far back as 1784 by Spalanzani. Longley[1], van der Stricht[2], Hill and Tribe[3], Courrier and Gros[4], Greulich[5], and Foster and Hisaw[6] have made more recent studies of this question, with somewhat contradictory results.

About seventy cats kept and bred in this Institute have been, during two years, observed and dissected. The results obtained are as follows:

The cat is a dicestrual animal, that is, one in which œstrus appears twice a year. The first cycle occurs in the spring, the second one in early autumn. In this respect, together with the other factors (change of habitation, for example), climate has a great influence. It may happen that these two cycles overlap during the summer months, whereas winter is mostly a period of complete rest from sexual activity. More frequent œstrus than twice a year has sometimes been observed by breeders of Angora cats. That is probably connected with advanced domestication. Normally œstrus lasts 3–5 days. By lack of service it may be prolonged to 10 days or more.

Numerous experiments have proved that ovulation invariably takes place after coitus. That is identical with the rabbit and the ferret. Up to this time, authors differed on this subject. It is interesting to note that a great number of interstitial cells appear in the ovaries of these animals in contrast with other mammals, including women, in which such cells are found either in very small numbers, or not at all. That would be a further confirmation of Ancel's and Bouin's[7] hypothesis, that the interstitial cells are connected with the above-mentioned symptom and have a restraining influence upon it. An extra nervous stimulus as is given by coitus is thus necessary for its accomplishment. Judging by the numerous interstitial cells which can be found in the ovaries of the above-mentioned three species of mammals, the hare and perhaps the mole ought also to be classified among animals with copulative ovulation.

In the female cat, ovulation occurs about forty to fifty-four hours after copulation. Graafian follicles which do not disrupt undergo an athresia; the granulous cells are partly subject to changes: cells of connective tissue grow out of the theca, interstitial cells undergo strong hypertrophy and grow towards the centre. Only a nucleus of connective tissue remains in the centre of the follicle. At first sight, this formation reminds one of the corpus luteum. Differences consist in their way of staining. The follicles undergo a process of athresia in all stages of development, already beginning at the period which precedes sexual maturity. As in the rabbit or ferret, a female cat served by a vasectomized male shows the phenomenon of pseudo-pregnancy, which lasts about thirty-six days.

The corpus luteum of pseudo-pregnancy is formed in the first instance of granulosa cells. The blossoming of the corpus luteum takes place after thirteen days, and twenty-eight days after copulation it undergoes a reduction simultaneously with the appearance of the growing Graafian follicles of the new cycle.

During the different phases of the œstrous cycle, considerable changes occur in the genital tract.

The histological aspect is analogous. During anœstrus, the tube presents a cylindrical epithelium without cilia, whereas on the contrary during œstrus the tube becomes enlarged, it is ciliated and produces a mucus which contains, according to some authors, nourishment for the eggs which traverse the tube after ovulation. Even more prominent changes occur in the uterus. When in anœstrus, we observe a flattened, single-layered epithelium and small inactive glands; during œstrus, on the contrary, the epithelium becomes cylindrical, though deprived of cilia, the glands attain a high degree of development and grow deeply into the endometrium. During pseudo-pregnancy, the development of the glands is still stronger and the endometrium grows out into large folds towards the lumen of the uterus. Lastly, the vagina also shows marked changes during the cycle: the epithelium thickens many times during œstrus, at the same time the superficial layers flatten considerably, become cornified, lose their nuclei and become thrown out of the lumen separately or in flakes.

Further work is in progress.

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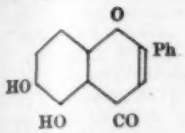
[1] *Amer. J. Anat.*, 12 (1911).
[2] *Arch. Biol.*, 26 (1911).
[3] *Quart. J. Micro. Sci.*, 68 (1924).
[4] *C.R. Soc. Biol.*, 114 (1933).
[5] *Anat. Rec.*, 58 (1934).
[6] *Anat. Rec.*, 62 (1935).
[7] *C.R. Soc. Biol.*, 58 (1909).

Synthesis of 5 : 6-Dihydroxyflavone and the Structure of Primetin

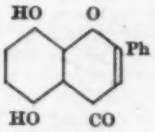
PRIMETIN, $C_{15}H_{10}O_4$, isolated from the leaves of *Primula modesta*[1], has hitherto been regarded as 5 : 6-dihydroxyflavone (I), and several attempts have been made to prepare this compound[2]. An unambiguous synthesis of 5 : 6-dimethoxyflavone has now been carried out via the stages 2 : 6-dihydroxyacetophenone, 2-hydroxy-6-methoxyacetophenone, 2 : 5-dihydroxy-6-methoxyacetophenone, 2-hydroxy-5 : 6-dimethoxyacetophenone, 2-benzoyloxy-5 : 6-dimethoxyacetophenone, and 2-hydroxy-5 : 6-dimethoxydibenzoylmethane.

Demethylation gave a dihydroxyflavone, which, because it regenerated 5 : 6-dimethoxyflavone on methylation and for other reasons, must be regarded as 5 : 6-dihydroxyflavone (I), and not the alternative 5 : 8-dihydroxyflavone (II), which might be produced by opening of the pyrone ring and closure in the alternative direction.[3] This substance and its derivatives differ widely from primetin and corresponding derived compounds, and a revision of the structure of primetin is therefore necessary.

It is of interest that Sugasawa[2] actually succeeded in preparing two derivatives of 5 : 6-dihydroxyflavone and even a crude specimen of 5 : 6-dihydroxyflavone itself, but, because the compounds were not identical with primetin and derivatives, he erroneously assumed that they were derived from 5 : 8-dihydroxyflavone (II).



(I)



(II)

A review of the available evidence leads to the conclusion that primetin is a dihydroxyflavone derived from hydroxyquinol, and must be regarded as 5 : 8-dihydroxyflavone (II). It is probable that another flavone of this type occurs naturally; this is the 4′-methoxy derivative of (II) isolated from the leaves of *Ginkgo biloba* L. by Furukawa[4]. The synthesis of these 5 : 8-dihydroxyflavones is in progress. A detailed account of this work will shortly be published elsewhere.

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April 8.

[1] Hattori, S., and Nagai, W., *J. Chem. Soc. Japan*, **51**, 162 (1930); *Acta phytochim.*, **5**, 1 (1930).
[2] Sugasawa, S., *J. Chem. Soc.*, 1621 (1933); *J. Pharm. Soc. Japan*, **56**, 105 (1936); Baker, W., *J. Chem. Soc.*, 1953 (1934); Mahal, H. S., and Venkataraman, K., *Current Science*, **6**, 450 (1938).
[3] See Shah, R. C., Mehta, C. R., and Wheeler, T. S., *J. Chem. Soc.*, 1555 (1938).
[4] Furukawa, S., *Sci. Papers Inst. Phys. Chem. Res. Tokyo*, **19**, 27, 39 (1932); **21**, 278 (1933).

Points from Foregoing Letters

B. F. J. Schonland and his associates present evidence supporting the view of Australian workers that the oscillatory structure of atmospherics arises from multiple reflections from the *E*-layer of the ionosphere. They find that the effective height of reflection is approximately constant (85 km.) except in the neighbourhood of the thunderstorm producing the atmospheric, where it decreases from 85 km. at 300 km. distance to 50 km. immediately above the storm.

The cross-sections for the transformation of nitrogen (^{14}N), when bombarded by fast neutrons, into boron (^{11}B) or carbon (^{14}C) are found by E. Baldinger and P. Huber to have the values $1{\cdot}63$ and $0{\cdot}4 \times 10^{-25}$ cm.^{2} respectively. The reaction energy for the nitrogen–boron transformation is $-0{\cdot}43$ Mev.

The crystal structure of α-chitosamine hydrochloride and hydrobromide has been determined by E. G. Cox and G. A. Jeffrey without the assistance of stereochemical data. The authors state that it proves the correctness of the configuration assigned to glucose derivatives, and in particular shows that chitosamine is definitely a derivative of glucose. The results also demonstrate the existence of the pyranose sugar ring and show that in α-glucose derivatives the groups attached to the first and second carbon atoms are in *cis* positions.

E. Holiday states that deductions from observation of change of absorption at λ 240 mμ as to whether CO groups are formed during enzymic digestion of a protein are not possible until account has been taken of the large masking effect due to accompanying change in absorption of the aromatic amino-acids.

Sedimentation curves for several proteins (thyroglobulin, antitoxic diphtheria pseudoglobulin and thymus nucleohistone) are submitted by H. P. Lundgren, indicating the formation of 'labile' components with lower sedimentation constants; this may be brought about by the simple expedient of increasing the protein concentration and reducing the electrolyte content of the solution.

A. J. Turner communicates a simple formula for calculating the relative humidity directly from readings of a ventilated wet- and dry-bulb hygrometer; the formula gives results accurate to 1 per cent relative humidity between 50 per cent and 90 per cent R.H., from 40° F. to 120° F.

D. N. Truscott reports a graphical method of circuit analysis and synthesis, based on the use of charts with logarithmic scales of impedance and frequency; this has been used in radio receiver design.

A survey of the structure of the Bermuda Islands by means of sound-velocity technique indicates, according to G. P. Woolard and M. Ewing, that the islands consist of four main volcanic cones with several minor ones, and are surrounded by a series of concentric folds which die out in amplitude with distance from the islands. Sound refraction measurements show the tops of two of the volcanoes to be at a depth of about 250 ft.

R. J. Pumphrey has recorded microphonic potentials in response to sound from the non-auditory part of the labyrinth of teleost fish. Such potentials are therefore not an absolute indication of the reception of acoustic or vibratory stimuli.

By isolating single cells of plankton diatoms (*Chætoceros*) and cultivating them in suitable media, T. Braarud has been able to follow the formation of ciliate microspores and to show that such spores represent a mode of reproduction in *Chætoceros*.

I. J. Kligler and H. Bernkopf describe experiments showing that it is possible to cultivate fixed rabies virus in the developing chick embryo provided that (*a*) the allantois of embryos 5 to 6 days old are infected, and (*b*) passages are made 9 to 10 days after the infection. Passages from embryo to embryo can be made with emulsions of either allantois or embryo brain.

H. Liche confirms the existence of copulative ovulation in the female cat and suggests that it is conditioned by the presence of numerous interstitial cells in the ovary. He describes the pseudo-pregnancy and anatomical as well as the histological changes which occur during the different stages of the œstrous cycle.

Primetin, isolated from *Primula modesta*, has previously been regarded as 5 : 6-dihydroxyflavone. This substance has now been synthesized by W. Baker, who finds that it is not identical with primetin. There can be little doubt that primetin is 5 : 8-dihydroxyflavone.

Research Items

Nuer Time-Reckoning

IN a study of Nuer time-reckoning by Dr. E. E. Evans-Pritchard (*Africa*, **12**, 2; 1939), it is pointed out that the Nuer have a sense of time different from ours, not merely owing to the fact that a system of time-reckoning in mathematical symbols differs from a verbal system not so reckoned, but also because both European and Nuer alike speak of time in terms of social activities and relationships, which in the two systems differ fundamentally. In Nuer concepts of time we may distinguish between those which reflect their relation to the environment, 'ecological' time, and those relating to the social structure, 'structural' time. The ecological cycle is a year of two main seasons, each divided into six months, one season, broadly, the wet, and the other the dry. The wet season is that of residence in villages, with appropriate occupational activities, and the dry that of residence in camps. The concepts of time are based primarily on the social rhythm, of which the outstanding quality is the movement from village to camp and back again. It is by reference to the changes in the character of their activities that they reckon time, and on them they base their calendar. Years are recalled generally by reference to the places at which their camps were made and the circumstances which arose during their stay there. Hence there is no accurate, or general, system of dating years. Each division of the Nuer has its own system of reference. A habitual method of dating an epoch, or certain events, is by reference to the age of certain persons, and this not by counting years, but by their relation with certain groups of persons. The interval between events is measured by the relation between the persons of one age group and those of another. Time can also be measured by employment of the genealogical method. Events integrate at a certain point in the clan system, and thus each person in the genealogy constitutes a significant point of reference.

Tshimshian Clan Relationships

THE clan relationships of members of nine tribes now resident at Port Simpson, British Columbia, were investigated by Viola E. Garfield in field work carried out in the summers of 1932, 1935 and 1937, with the purpose of defining more clearly the functioning relationships of Tshimshian individuals to each other as determined by their clan and tribal affiliations (*Univ. Washington Pub. in Anthropology*, **7**, 3; 1939). In summarizing these relationships, those which are old and still functioning are differentiated from those which are now obsolescent, or those which have grown out of white impact. Closest contacts were with members of the father's and mother's lineages. Children usually lived with the mother in a household composed largely of the father's relatives; but they were taught that their homes were with their maternal uncles, with whom the boys went to live at adolescence. At the present day, however, children grow up under the father's care, and are less influenced by lineage relations. The duties of a father and his lineage towards his child are well formulated. The father's brother and sister are privileged to perform the first services to the child at birth. The father's brother provides the cradle, while his sister acts as midwife—services now obsolete, owing largely to the provision of hospitals. At the giving of the first name, the maternal uncle gave the name, but it was proclaimed by the father's brother; and in the first power ceremony the father's sister acted as the child's assistant. No power ceremonies now take place. The ear, lip, and nose piercings were performed by a woman of the father's lineage. A paternal aunt assisted in the wedding preparations and the father's sister was the bride's chief attendant. The father's sister cared for the body of the deceased after death, being compensated by the clan relations, while the father's brother provided the coffin.

Metabolism and Castration

M. Sandberg, D. Perla and O. M. Holly (*Endocrinology*, **24**, 503; 1939) studied the effect of castration in male and female albino rats on nitrogen, sulphur, chloride, sodium and potassium metabolism and on changes in weight and food intake. They found that if the gonads were removed after puberty, nitrogen, sulphur, chloride, sodium and potassium metabolism either decreased slightly or remained unchanged. If castration occurred before puberty, urinary nitrogen excretion increased considerably, urea nitrogen accounting for the increase. Ammonia nitrogen, uric acid, creatine, creatinine and fæcal nitrogen excretion remained unchanged. Exogenous, as well as endogenous, sulphur metabolism was disturbed. Total sulphur excretion rose as well as that of neutral sulphur. After a period of seven months, endogenous sulphur metabolism began to return to normal. Chloride, sodium and potassium retention was decreased. The weight curves and food intake of male and female rats which had been castrated before puberty were similar to those of normal animals. The weight curves of male rats which had been castrated after puberty were similar to those of normal animals up to the age of 30 weeks. Then the curves of the castrates flattened out and at 40 weeks of age the controls weighed 10 per cent more. Food intake expressed in gm. per 100 gm. body weight was somewhat higher in normal animals up to a weight of 270 gm. Afterwards it was the same for both groups. The weight curves of female rats which had been castrated after puberty showed a gain in weight over the controls in spite of the fact that their food intake expressed in gm. per 100 gm. body weight was less.

Synthesis of Cystine in Rats

E. F. Beach and A. White (*J. Biol. Chem.*, 127, 87; 1939) placed a group of male rats on a diet of the following composition: cystine-free casein hydrolysate 14·7, tryptophane 0·3, crisco 21, cod liver oil 5, Osborne and Mendel salt mixture 4, and starch 55 per cent. Each rat received in addition a daily supplement of 100 mgm. of ryzamin B and 50 mgm. of liver extract, which provided sufficient water-soluble vitamin to permit a fair rate of growth. This vitamin supplement represented the only possible dietary source of cystine, inasmuch as the casein hydrolysate used in the diet was cystine-free. Moreover, analysis of the animals showed that young rats restricted to this diet for a period of approximately six weeks

usually deposited a quantity of cystine which was considerably in excess of the amount present at the start of the experiment plus the small amount possibly present in the vitamin supplement. The authors conclude that cystine *per se* is not a dietary essential, but may be synthesized from methionine.

Migrations of Pacific Mackerel

THE range of the Pacific mackerel, *Pneumatophorus diego*, covers nearly 2,000 miles from Vancouver Island to Lower California. Since 1928, the fish has been extensively used for canning, and the opportunity has been taken to mark large numbers so that questions of spawning and other movements may be elucidated (Donald H. Fry, jun., and Phil. M. Roedel in *California Fish and Game*, **25**, 2; 1939). From 1935, when the marking programme was launched, to 1938, 16,848 had been tagged by metal tags which were either clamped on a gill-cover (an unsuccessful method because the tags do not stay in place), or were inserted through a tiny slit into the body cavity. The tags are recovered by magnets during the processes preparatory to canning, or are sent in by fishermen for a small monetary reward. In order to determine relative movements of different shoals 5,403 mackerel were marked at Monterey, 10,184 in southern California, and 1,261 in Lower California. The tag returns seem to be disappointingly few, in all only 412 (out of 16,848), and of these 233 were taken within ten miles of the place of release; 130 were recovered by cannery magnets in the same general area in which they were marked, and 49 were found more than ten miles from the place of release. The recoveries show that there is an interchange of fish between Monterey and southern California and a mingling of fish from different parts of the southern Californian area. The time which has elapsed between tagging and recovery has been as long as two years, and some of the more rapid rates of movement shown by marked fish are 21 miles in twenty hours, and 200 miles in thirty-four days.

Corpuscles in Body Fluids of Invertebrates

SINCE 1934, Toshio Ohuye has been conducting a series of investigations into the characteristics of the corpuscles to be found in the body fluids of invertebrates. The findings of eleven of these inquiries have already been published in the Science Reports of the Tôhoku Imperial University. In the issue of the *Journal* for December 1938, the author summarizes the previous work and sets forth his general conclusions. The investigations cover forty-four invertebrate animals belonging to six phyla. The author considers that there is no fundamental hiatus between the erythrocytes of invertebrates and those of vertebrates. Those of invertebrates constantly contain inclusions which are of a substance analogous with that found in the granules included in the leucocytes. Thus the erythrocytes can be regarded as modified leucocytes. Thus the lymphocyte may be regarded as a pluripotential element capable of differentiation along several lines, the particular one followed being dependent upon the individual environmental requirements. The invertebrate blood is characterized by the presence of many and variously pigmented leucocytes.

Sterility in Plums

CONTINUING their studies on incompatibility of fruit trees, M. B. Crane and A. G. Brown (*J. Pom.*, 17, 51–66; 1939) show that self-incompatibility, cross-incompatibility and partial incompatibility exist in the plums. The existence of self-compatible varieties together with the complex behaviour in respect of intervarietal compatibility is due in large measure to the hexaploid constitution of the plum. The authors show that the old greengage variety exists as a population of different strains which are intercompatible. These strains have several distinct morphological features and they may be either seedlings of one parent or bud sports from one plant. The application of the experimental results to economic practice is discussed.

Earthquake in Chile, January 24, 1939

A SHORT article on this earthquake, written by Julio Bustos Navarrete, director of the Salto Observatory, Santiago, has recently appeared (*Rev. pour l'étude des Calamités*, **2**, No. 5, March–April 1939). The author states that the region principally affected was that of Chillan-Concepcion-Cauquenes and that previous occurrences affecting the same area were on May 25, 1751, and February 20, 1835. On January 24, 1939, a series of shocks commenced with light rockings at 23h. 35m., each lasting about three minutes. These gradually became stronger until the climax was reached when a terrific shock occurred, followed by after-shocks. The earthquakes are considered to have been due to an orogenic movement which, being shown by inclinographs, was mentioned in the *Bulletin d'études de l'Observatoire de Salto* in November 1938. It was then stated that the culmination would probably be a series of small shocks or a larger one, though in the present state of the science the exact time and place of these shocks could not be foretold. The anticipated seismotectonic process commenced on January 17 by a shock of intensity V felt at Coquimbo and La Serena and on January 18 by a shock of intensity IV felt at Antofagasta and La Pampa. These were interspersed and followed by minor ones. The shock of January 24 reached a probable intensity XI at Chillan and Cauquenes, and in general the intensity decreased with epicentral distance. There were, however, some exceptions owing to the geological structure of the country, such as at San Carlos and San Gregorio between Chillan and Cauquenes, where the intensity was not above VIII. About the same time as the shock, the volcanoes Quizapu, Antuco and Llaima are reported to have erupted. The author supposes that a 'trigger' action may have been the passage of the centre of a strong anticyclone over the south of Chile at the time, and mentions reports of observations of brilliant lights, thunder, lightning, rain, hail, and peculiar atmospheric conditions accompanying the shock.

Zoned Olivines

AN important investigation of zoned olivines and their petrogenetic significance by S. I. Tomkeieff has recently been recorded (*Min. Mag.*, 229–251, March 1939). The widespread occurrence of zoned olivine in igneous rocks is demonstrated by measurements of the optic axial angle—which varies with the composition in the forsterite-fayalite series—supplemented by determinations of other serial properties such as refractive indexes and birefringence. As a rule, the zoning is found to be continuous, varying from a magnesium-rich centre to an iron-enriched margin. The difference in composition between centre and rim exceptionally reaches 40 per cent fayalite. The olivine in the British Tertiary dolerites

ranges between 18 per cent fayalite in the core to 40 per cent in the outer zone, but in the British carboniferous dolerites the corresponding average range is lower, being 31–39 per cent of fayalite. Data are assembled to show that there is an intimate connexion between the composition of the magma and that of the olivines crystallizing out of it at different stages of solidification or differentiation. The recorded observations on natural olivines and the rocks in which they occur are in complete agreement with the results of the recently published study of the forsterite-fayalite binary system by Bowen and Schairer (*Amer. J. Sci.*, 29, 151; 1935).

Origin of the Earth's Magnetic Field

W. M. ELSASSER (*Phys. Rev.*, 55, 489; 1939) has devised a thermo-electric theory of the origin of the earth's magnetic field. It is known that the electric currents which produce the magnetic field must be located inside the earth, and there is considerable evidence to show that the deep interior core of the earth is fluid and metallic. The continuous production in the core of heat which is lost from the outside leads to up and down convection currents just as in the atmospheric vortices of meteorological theory. The combination of these convection currents and the rotation of the earth leads to Coriolis forces perpendicular to the convective motions. These forces produce an asymmetry in each vortex such that there is an upward motion in the eastern part and a downward motion in the western part. At any horizontal level in any given vortex, the motion leads to an asymmetric temperature distribution. It is probable that this is accompanied by an asymmetric variation of the thermo-electric properties, due to phase changes in the material. A numerical calculation, with temperature variation of the order 10°, leads to currents of the right order of magnitude to account for the earth's magnetism, and the theory accounts indirectly for the rough coincidence of the earth's rotational and magnetic axes. The thermo-electric mechanism does not account for the magnetism of sunspots, which are probably due to currents in the upper layers of the sun's atmosphere.

Isotopic Abundance and Atomic Weight of Europium

THE abundance of the isotopes of europium was determined by Aston in 1934. He found two isotopes of mass numbers 151 and 153 respectively, the former having an abundance of 50·6 per cent and the latter of 49·4 per cent. Using the packing fraction $(4 \pm 2) \times 10^{-4}$, and the correction factor (0·999725) for the conversion of the atomic weight from the physical to the chemical scale, the value of the atomic weight obtained was $151{\cdot}19 \pm 0{\cdot}03$. Recent determinations of the atomic weight of europium by chemical methods carried out by Baxter and Tuemmler give 151·963. Kapfenberger (*Z. anorg. Chem.*, 238, 273; 1938) obtained the value 151·901 by determining the ratios $EuCl_3 : 2Ag$, and $EuCl_3 : 2AgCl$. H. Lichtblau now reports the results of a reinvestigation of the isotopic abundance of europium (*Naturwiss.*, 27, 260; 1939). Details of the method are given, and the result obtained is $^{151}Eu : ^{153}Eu = 96{\cdot}3 \pm 1{\cdot}2 : 100$. Other isotopes were not found, and if they exist the upper limit of their abundance is 0·4 per cent. The mean mass number calculated from the abundance is $152{\cdot}019 \pm 6 \times 10^{-3}$. Using Dempster's value for the packing fraction, $(2 \pm 0{\cdot}5) \times 10^{-4}$, and the above-mentioned correction factor for converting the physical to the chemical atomic weight, the atomic weight is calculated to be $151{\cdot}95 \pm 0{\cdot}01$. Using Aston's value for the packing fraction, the atomic weight is $151{\cdot}92 \pm 0{\cdot}03$.

Overhead Line Vibration

THE paper on the vibration of overhead line conductors by Messrs. E. W. W. Double and W. D. Tuck, read to the Institution of Electrical Engineers on April 12, is a useful contribution to an important practical problem. When a smooth cylindrical body is placed in a fluid moving with steady velocity at right angles to the axis of the body, it is known that the formation of eddies in the fluid behind the body depends on the velocity of the fluid, the length of the axis of the cylinder and the dynamic viscosity of the fluid. A simple formula derived from these three quantities leads to Reynolds' number, the value of which enables us to find the velocity of the water flow when it changes from steady streamline flow to the turbulent condition when eddies are formed behind the cylinder. The generally accepted theory is that vibrations are set up when the eddy frequency of the vortices coincides with one of the elastic periods of the vibrating line. This causes resonance, which initiates and maintains vibrations. Field observations were made on the vibrating conductors consisting of 100-ft. lengths of stranded steel-cored aluminium conductor in air, under given controlled conditions of vibration, to get data on the behaviour of the conductor and clamps and the maximum bending stresses induced in the conductor. It was thought that when these data were found, it would be possible to deduce the maximum safe 'stringing' tension of the line, assuming that it depended mainly on the repeated bending stresses. A study of cables broken at the end of the suspension clamp showed that the 'scoring' of the aluminium wires aided by abrasion weakened them so that full use was not made of the fatigue strength of the aluminium. The actual break occurs at points where the wires were 'nicked'.

Energy Production in Stars

THERE have been many attempts to account for the production of energy in stars with the aid of atomic transmutations. A. A. Bethe (*Phys. Rev.*, 55, 434; 1939) has now described in detail a cyclical scheme of reactions in which reactions between protons, carbon, nitrogen and oxygen nuclei result in the combination of four protons and two electrons into an α-particle:

$$C^{12} + H \rightarrow N^{13}; \; N^{13} \rightarrow C^{13} + e^+; \; C^{13} + H \rightarrow N^{14};$$
$$N^{14} + H \rightarrow O^{15}; \; O^{15} \rightarrow N^{15} + e^+; \; N^{15} \rightarrow C^{12} + He^4.$$

It is shown that the probabilities of these reactions, at a temperature of about 20 million degrees, corresponding to the central temperature of the sun, give about the right rate of energy production for that body. The dynamics of the process are also consistent with the mass luminosity relations which have been observed among the stars. Nuclear reactions other than these are examined and shown to play little part in the energy production—in particular, it is not possible for elements heavier than He^4 to be built up continuously in ordinary stars, and these elements must have existed already when the star was formed. In some faint stars, however, it is possible that energy is produced by the reaction

$$H + H \rightarrow D + e^+.$$

International Standard of Concert Pitch

By Dr. G. W. C. Kaye, O.B.E., F.R.S.

THE question of the international standardization of concert pitch, to which reference has already been made in NATURE (November 5, 1938), was the subject of an International Conference on May 11 and 12 last, under the auspices of the International Standards Association (I.S.A.). The Conference, which was held at Broadcasting House by the courtesy of the British Broadcasting Corporation, was organized, at somewhat short notice, by the British Standards Institution under its director, Mr. Le Maistre. Five countries (France, Germany, Great Britain, Holland and Italy) sent delegates, while the official views of Switzerland and the United States of America were before the Conference. The International Union for Broadcasting (U.I.R.), and the International Consultative Committee on Telephony (C.C.I.F.) were also represented by delegates. The president of the Conference was Dr. G. W. C. Kaye, chairman of the British National Committee on Acoustics, and the British delegation consisted of Dr. Kaye, Dr. F. W. Alexander, Captain E. H. T. Broadwood, Mr. Ll. S. Lloyd and Mr. Henry Willis.

The Conference was formally opened by Sir Cecil Graves, deputy director-general of the B.B.C., who, after welcoming the delegates, pointed out that the fixing of a new concert pitch is a problem for the musician to decide, after which the aid of the technician must be sought to help the musician to use and maintain the pitch he has chosen. Although it is probable that the extreme range of variation of the pitch of orchestras the world over does not exceed a semitone, it was scarcely necessary to stress the increased comfort and assurance of a standardized pitch to singers and to players of concertos for stringed instruments. There is no doubt, too, that the manufacturers of musical instruments, particularly of organs and pianos, would welcome a standardization which would relieve them of the frequent necessity of re-tuning. As regards listeners to music, whether in the concert hall or through the medium of broadcasting, no real comparison on the score of brilliancy of two different performances of the same symphony by different conductors is possible unless the two performances are based on the same pitch. In these days of emotional stress, it is no small achievement for nations to come together to discuss a subject that is very much bound up with the emotional factor. General agreement on principles and practice might well be a promising portent for the future of the world.

In his opening address, the President reminded the delegates of the occasions in the past when agreement had been sought on the present question, but no outstanding measure of international unification had ever resulted. He hoped that before the Conference dispersed, it would have set up a musical milestone of lasting significance. The question of an international standard of concert pitch, while always of commercial importance in the international trading of musical instruments, has assumed a new prominence in view of the requirements of international broadcasting and the development of electro-acoustical instruments. It was in fact the urgent requirements of the International Broadcasting Union which finally led to the decision to endeavour to bring about international agreement.

After suggesting that the Conference should confine itself to the standard convention of expressing concert pitch in terms of the note *A* in the treble clef, brief reference was made to the historical background of concert pitch—to the early and pronounced meanderings of pitch during the fourteenth to the nineteenth century; to the first attempt at standardization a century ago in Great Britain, namely, the philharmonic pitches of 433 in 1826 and of 455 in 1845; to the value, 440, adopted by the Stuttgart Conference in 1834; to the French Diapason Normal, 435, of 1859, and its endorsement by the International Congress of 1885 in Vienna. In the United States, a figure of 440 is now general after many vagaries, while as regards Great Britain, reference may be made to the standardization at 439 of piano pitch by the piano makers in 1899, and to the lowering in 1927 of the pitch of the British Army bands from 455 to 439. The first question before the Conference was virtually that of reviewing the present general upward departure from the standard adopted in Vienna more than fifty years ago. Incidentally, so far as actual frequency measurements go, the standardization requirements of musical pitch present an easy problem to the physicist who can, if desired, measure frequency to an accuracy of 1 in 100 million.

A survey of the reports submitted by different countries to the Conference indicates that the present position can well be regarded as propitious for international agreement:

	Treble *A* (cycles per sec.)
French Standards Association, proposes	440
German Standards Association, proposes	440
American Standards Association, proposes	440
British Standards Institution, proposes	440
Dutch Acoustics Committee, agrees	440
Swiss Standards Association, agrees	440
International Union for Broadcasting, suggests	440
Italy has adopted	435±4
Mean of European Concert Broadcasts	443
Electric organs, American	440
Electric organs, British	439

A friendly and vigorous discussion followed, during which it was happily found possible to establish eventual agreement on the main points at issue. Thereupon, taking cognizance of the general lack of observance of the Vienna standard (435) in favour of an appreciably higher though variable figure, which moreover shows a constant and regrettable tendency to increase, and having regard to the æsthetic, technical and economic importance of early international standardization within the limits of existing practice, the Conference unanimously agreed to forward the following recommendations to the parent International Acoustics Committee for submission to, with a view to ratification by, the national standardizing bodies affiliated to the International Standards Association; also to the U.I.R., the

C.C.I.F. and the International Electrotechnical Commission (I.E.C.):

(1) That the international standard of concert pitch shall be based on a frequency of 440 cycles per second for the note A in the treble clef. ("La normale".)

(2) That this value shall be maintained within the closest limits possible, by soloists, orchestras, choirs, etc., throughout all musical performances, and also in recorded music.

(3) That with a view to reducing the necessary tolerances to acceptable values, a set of technical recommendations be drawn up, preferably on the basis of international co-operation.

An appendix to the recommendations relates to a future programme of study designed for early discussion, so as to render effective as soon as possible the practical observance of the new standard concert pitch: for example, the differential influence of temperature on the various orchestral instruments and the consequential tuning adjustments before and during a performance; the feasibility of transmitting the standard pitch by means of broadcasting or telephone; the provision of sub-standards of pitch, portable or otherwise, and the advisability of their verification by an official laboratory; the production of specifications dealing with the appropriate tolerances in the manufacture of musical instruments; and the setting up of supervisory safeguards, both national and international, for verifying the observance of the new standard pitch and so preventing the possibility of its falling into desuetude, as has occurred with the Vienna standard.

The success of the Conference was a happy vindication of the decision to go forward with the plans for bringing the delegates of the different countries together, despite the troubled nature of the times. The delegates further consorted in complete and amicable accord on the occasions of visits to the Acoustical Laboratory of the National Physical Laboratory by the kind invitation of the Director, and to Lyne, Capel, Surrey, at the invitation of Captain Broadwood, whose beautiful house and estate, in all the glory of the spring foliage, formed a lovely setting for his genial hospitality and the delightful unaccompanied old English melodies of the famous Tudor Singers under the direction of Mr. Cuthbert Bates.

Telephony in the United States

THE annual report by the directors of the American Telephone and Telegraph Co. for the year 1938 is of great interest. The taxes last year were equal to about 80 cents per month per telephone, which is about 14 per cent of the average telephone bill, or about one third of the total pay roll. Notwithstanding the heavy taxation and increased wages, the earned dividends for the last two years were nearly the same.

Until 1927, the longest distance a telephone call could be made was about 3,000 miles; to-day there is no limit. We can talk round the world. The improvement in transmission on a call from New York to San Francisco as compared with twenty years ago when trans-continental service was inaugurated is roughly equivalent to the difference between conversing in an open field at a distance of several hundred feet and conversing with someone in the same room at about one third the cost. Five years ago the time of making a long-distance connexion was reduced from 7·5 minutes to 3 minutes. Last year a direct radio telephone circuit from San Francisco to Australia was made, replacing the original route from New York via London. This new circuit is several thousand miles shorter and made possible a substantial reduction in the price of a call.

The ocean liner *Nieuw Amsterdam* has been added to those with which the Bell system operates ship-to-shore radio telephone service. Twelve shore stations of the Bell system and its connecting companies now serve nearly a thousand small vessels on the Atlantic and Pacific coasts and on the Great Lakes.

The damage experienced by the destructive effects of fires, floods, tidal waves and hurricanes in 1938 was the most extensive ever experienced. In September all these destructive forces combined, causing a disaster in the eight north-eastern States affecting the greatest number of telephones and communities since the telephone was invented. More than half a million telephones were silenced, and 240 communities were isolated. The wreckage of telephone plant put the Bell system to the greatest test it had ever been called on to face—a test of the organization, of its men and women, and of its resources of equipment and supplies. More than 2,300 trained men with 615 motor-vehicles were loaned by fourteen telephone companies. Enormous quantities of materials were rushed in promptly by the Western Electric Co. The Bell companies in the stricken area, assisted by the resources of the entire Bell system, successfully met the challenge of the catastrophe, the telephone men and women, unmindful of hardship, carried on with resourcefulness and courage, and the result was an almost impossible job splendidly done.

Research in the field of radio telephone transmission has been specially pushed in the direction of increasing the efficiency and the steadiness of trans-oceanic circuits in anticipation of the adverse conditions likely to occur in 1940 and 1941 at the time of the expected maximum effect of sunspot disturbance. Highly efficient adjustable directional antennæ have been prepared. One of these, two miles long, is now being installed in the trans-Atlantic route. Two noteworthy achievements in civil and military aeronautics were made last year. One was the development of an accurate instantaneous terrain clearance indicator by which a pilot is at all times apprised of his height above the ground. The other was the development of an aeroplane locator for use at ground stations. By dialling the frequency of the aeroplane radio, the airport operator can see on a map the direction of any aeroplane within range. This should be of great value in reducing risks to aeroplanes in bad weather.

The Company has a memorial fund which provides annual awards in recognition of unusual acts of service. This year one (posthumous) gold medal with £100 and thirty-two bronze medals were awarded to individuals, and four special bronze plaques were awarded to groups of employees in recognition of their skill, courage and devotion to duty along the Ohio River Valley during the flood of January 1937.

Jubilee of Johns Hopkins Hospital

"LET us hope," said John Shaw Billings at the opening on May 7, 1889, of the Johns Hopkins Hospital in Baltimore, "that before the last sands have run out from beneath the feet of the years of the nineteenth century, it will have become a model of its kind, and that upon the centennial of its anniversary it will be a hospital which shall still compare favourably, not only in structure and arrangement, but also in results achieved, with any other institution of like character in existence."

Half a century has rolled by since that memorable day, full of pride, tradition, and famous men whose names continue to shine with undiminished brightness in the medical firmaments: Osler, Welch, Halsted, and Kelly. The intellectual child of that wealthy Baltimore bachelor and banker John Hopkins, when the hospital opened its doors, it consisted of seventeen buildings with two hundred and thirty beds, seven graduate head nurses, and seventeen probationers. There were but four services: medical, surgical, gynæcological, and pathological. To-day "Hopkins" has developed into a medical centre with 1,024 beds and 590 nurses.

On May 4, 5, and 6 a large number of old Hopkins people, medical men and nurses, and many distinguished visitors gathered together at Baltimore to celebrate the fiftieth birthday of an institution of which it has been said that it has become more famous than the historic city beyond its walls. At the exercises held on the green lawn of the hospital on the afternoon of May 4, Dr. James B. Herrick, "dean of American physicians", described Osler's text-book of medicine as Johns Hopkins's greatest single contribution to medicine. A serious note was struck by the Hospital's director, Dr. Winford H. Smith, who suggested that the days of great individual fortunes are passing and with them the days of great philanthropies and benefactions, so that one of the prime problems of the hospital of the future will be increasing dependence upon Government for support. In the evening a historical play, "The Flowering of an Idea", written by Dr. Alan M. Chesney, dean of the Medical School, and dealing with the early development of the Hospital, was performed.

A carefully planned and fascinating programme consisted of exhibits, lectures, demonstrations, and conferences. Among others, Dr. Simon Flexner spoke on "The Nuffield Benefaction and the Full-Time Chairs at Oxford". At a reunion dinner attended by some thousand medical men and nurses, Dr. J. M. T. Finney acted as toastmaster, and the speakers included Dr. Howard A. Kelly, the only surviving member of the "Big Four" immortalized in Sargent's painting, and Dr. Lewellys F. Barker.

The eyes of the scientific world will be focused upon Johns Hopkins Hospital during the next fifty years of its existence. It has had a great past, and its responsibility towards the future is enormous beyond reckoning. "A city that is set on a hill cannot be hid."

WALTER BETT.

Scientific and Industrial Research in Australia

THE twelfth annual report of the Council for Scientific and Industrial Research, Commonwealth of Australia, covers the year ended June 30, 1938.*

The most important development during the year was the decision of the Government to extend the work of the Council for the secondary industries, for which purpose the sum of £250,000 was appropriated for capital expenditure, involving establishment of the Standards Laboratory and an aeronautical and engine testing laboratory and an information section. A site has been offered by the University of Sydney for the Standards Laboratory within its own grounds. It is proposed that the laboratory should be organized in sections for meteorology, electro-technology and physics. The aeronautical laboratory is to be located in Melbourne, for which purpose a site has already been acquired. In addition to providing the information service visualized by the Secondary Industries Testing Research Committee, the proposed information section is intended to initiate research work in co-operation with industry, and the Imperial Agricultural Bureaux plan will be extended to include other branches of science and industry than agriculture. In addition to the preparation of bibliographical references, the work of the section will cover the supply of scientific and technical information, the preparation of information relating to recent advances in the application of science to industry, etc., the preparation and publication of articles, Press statements, reports, etc.

The report gives brief reviews of the work carried out by the various departments of the Council. The Division of Plant Industry has continued its work on the breeding of pasture plants, the storage of fruit and on the root rot of wheat. Tobacco investigations have included the control of downy mildew, and a survey is being made of the potato virus diseases of Australia.

The work of the Division of Economic Entomology during the year on the sheep blowfly pest has been concerned with the study of attractiveness, the development of standard methods of testing poisons and investigations of dressings. Further work has been carried out on the control of codling moth with the particular object of finding an efficient alternative to lead arsenate.

The Division of Animal Health and Nutrition occupied the new animal health research laboratory at Melbourne during the year, and work on pleuro-

* Parliament of the Commonwealth of Australia. Twelfth Annual Report of the Council for Scientific and Industrial Research for Year 1937-38. Pp. 96. (Canberra: Government Printer, 1939). 4s.

pneumonia in cattle and mastitis in dairy cattle was continued. The Division has also continued its studies in fleece chemistry, yield and fibre measurement and on the sheep blowfly problem, and an investigation on sheep dips was initiated during the year.

In addition to continuing its various soil surveys, the Division of Soils has been concerned with the use of a spectrograph and the polarograph for the determination of traces of metals in soils and in plant and animal diseases.

The work of the Division of Forest Products has continued to expand during the year and, in addition to the chemistry of wood and pulp and paper investigations, has been concerned with the preservation of timber, the seasoning of timber and various problems in the wood manufacturing industry.

The Division for Food Preservation and Transport occupied its new laboratory at Homebush Bay, Sydney, during the year and has completed its work on the cooling of beef in sides. Other work has dealt with the loss of bloom on chilled beef, the storage of oranges, peaches, plums, pears and grapes as well as on apples and eggs. Further progress has been made during the year by the Council in the provision of staff and facilities for fishery investigations, in which aerial reconnaissance has again been used.

The Dutch Congress of Natural Science and Medicine

THE twenty-seventh Dutch Congress of Natural Science and Medicine was held at Nimeguen, Holland, during April 11–13, under the presidency of Prof. G. Holst. Reference was made to the general lectures in the programme in a note in NATURE of April 1, p. 554. At a joint meeting of the physical and chemical sections Prof. Errera, of Brussels, gave a special address to the Congress on his investigations of the absorption of organic compounds in the infra-red part of the spectrum. Besides the well-known absorption bands belonging to special atomic configurations, new absorption bands appear which must be ascribed to multi-molecules (association). In solutions, there appear special bands due to the interaction of an atomic group of the solvent with the molecule in solution.

MATHEMATICAL PHYSICS AND PHYSICS

Among the papers presented to the section on mathematical physics, the following may be mentioned. Methods of approximation of the general wave equation were discussed with special reference to the Schrödinger equation. Prof. de Laer-Kronig treated a new perturbation theory, leading to a difference equation, which can be solved numerically by the application of an extension of the well-known Wentzel-Kramers-Brillouin approximation. It was shown by Prof. Zernike that the intensity of light in the vicinity of a focus can be described, even for the most general boundary conditions, by a special kind of orthogonal functions, introduced by him. Dr. Bremmer demonstrated that the Wentzel-Kramers-Brillouin approximation of the wave equation may be considered as the first of a series of terms, which can all be interpreted physically. Ehrenfest's theorem of the classical motion of the centre of a wave packet describing a particle in quantum-mechanics was extended by Prof. Fokker for a very general type of propagation equation.

In the physical section, Dr. Matthijs gave an account of measurements on the thermo-electric force of superconducting metals in the neighbourhood of the transition point, showing that superconductivity becomes evident at a temperature superior to the transition point.

In a discussion on nuclear physics, Mr. Barendregt reported experiments on pair formation by β-rays, which process appears to take place much more frequently than theory predicts. Dr. Heyn gave an account of experiments, made in collaboration with Mr. Aten, jun., and Dr. Bakker, on the fission of the uranium and the thorium nuclei by neutron bombardment. From experimental evidence it follows that these nuclei can break up in more than one way.

CHEMISTRY

In the chemical section, Mr. van Pelt communicated experiments on the bromination of pyridine and compounds containing a pyridine ring. It is found that, depending on the temperature, either *ortho-* or *meta*-substitution occurs. Dr. Heertjes dealt with the measurement of the density of fibres. A gas-volumetric method with helium was used. Evidence was produced for the assumption that water is absorbed by cotton in two different ways. Prof. Aten described an objective colorimeter which can be constructed at very low cost using ordinary laboratory apparatus. Mr. Troelstra discussed the latest improvements in electrodialysis.

BIOLOGY

The programme of the biological section contained a large variety of communications. The main topic was the need of magnesium in plants (O. de Vries) and animals (Sjollema). Further botanical subjects dealt with were the transport of substances (Arisz), the relation between yield and the ratio between roots and sprouts (Boonstra), bacterial leaf-symbionts (De Jongh), antagonisms between micro-organisms (Westerdijk), the influence of colchicine on nuclear divisions (Wellensiek) and problems in the rooting of cuttings (Funke, Hubert and Rappaport).

Zoological subjects discussed included: Colorado beetle (Roepke), the life of termites in the Netherlands Indies (Kalshoven), metabolism in trypanosomes as a basis for control (Krijgsman) and the power of orientation of migratory birds (Van Dobben).

In addition, pollen analysis investigations (Florschütz), vertebrate fauna (van der Vlerk) and botanical investigations (Polak) of the quaternary in the Netherlands were discussed in the geological section, while the general lectures of Ornstein on physics and biology and of Gorter on very thin membranes attracted considerable attention from biologists.

University Events

CAMBRIDGE.—G. Manley of Gonville and Caius College has been appointed University demonstrator in geography.

The Board of Management of the Frank Edward Elmore Fund will shortly proceed to the award of two studentships for research in medicine. The studentships are open to male graduates of any University who were born in any country within the British Empire other than Scotland. The students appointed will work in the Department of Medicine of the University of Cambridge under the direction of the regius professor of physic. The commencing salary will be £300 a year, and the appointment will be for two years in the first instance. Further information may be obtained from the regius professor of physic, Department of Medicine.

The following have been elected to fellowships at St. John's College: Dr. W. A. Deer, Strathcona research student (1934), Royal Commission for Exhibition of 1851 senior student (1938), formerly at the University of Manchester. F. Hoyle (Emmanuel College), Part I, Mathematical Tripos, Class I (1934), Part II, Mathematical Tripos, Class II (1935), Part III, Mathematical Tripos, honours with distinction (1936), Mayhew Prize (1936), Goldsmiths' senior student (1937), Smith's Prize (1938).

LEEDS.—The Council has received the following donations: £50 from the Education Committee of the National Association of Local Government Officers to assist in the encouragement of the study of public administration; £110 from the Anglo-Saxon Petroleum Company (Royal Dutch Shell Group) for a scholarship tenable in the Mining Department.

LONDON.—Prof. W. E. Le Gros Clark has been appointed as from October 1 to the University chair of anatomy tenable at University College. He has held University chairs of anatomy at St. Bartholomew's Hospital Medical College and at St. Thomas's Hospital Medical School, and since 1934 he has been professor of anatomy in the University of Oxford.

Dr. Samuel Nevin has been appointed to the University chair of the pathology of mental disease tenable at the Maudsley Hospital. He will take up his duties in September next.

Dr. Patrick D. F. Murray has been appointed, as from October 1, to the University readership in biology tenable at St. Bartholomew's Hospital Medical College. He has held a Rockefeller travelling fellowship and a Smithson research fellowship; and since 1937 he has held a teaching post in the Department of Zoology at Bedford College.

The title of reader in economic statistics, with special reference to mathematical economics, in the University has been conferred on Mr. Roy G. D. Allen in respect of the post held by him at the London School of Economics.

The title of professor emeritus of medicine in the University has been conferred on Prof. T. R. Elliott on his retirement from the professorship of medicine and the directorship of the Medical Unit at University College Hospital Medical School.

The degree of D.Sc. has been conferred on Mr. C. L. Wilson, an internal student, of University College and on Mr. F. G. Young, an internal student, of University College.

Science News a Century Ago

The Royal Geographical Society

THE eighth anniversary meeting of the Royal Geographical Society was held on May 27, 1839. According to the annual report, sixty-three new members had been elected; and the Society consisted of 651 members, and sixty foreign, honorary and corresponding members. The president, in handing a gold medal to Chevalier Bunsen to be sent to the naturalist and traveller Dr. Wilhelm Rüppell (1794–1884) of Frankfort, said that the medal was awarded in testimony of Dr. Rüppell's services in the advancement of physical geography. Dr. Rüppell had made three journeys into Africa. After the first he had placed himself under the tuition of the learned Baron von Zach. He then returned to Egypt, visited Arabia, the gulf of Akabah (which he was the first to explore geographically), Abyssinia and Kordofan. All the produce of his travels in the department of zoology, which absorbed a large part of the pecuniary means at his disposal, he had generously made over to his native city.

Daniell's Constant Battery

ON May 30, 1839, at a meeting of the Royal Society, the fifth letter of J. F. Daniell to Faraday on voltaic combinations was read. The letter also gave an account of the effects of a large constant battery. The constant battery consisted of seventy cells in a single series, which gave, between charcoal points separated a distance of three-quarters of an inch, a flame of considerable volume, forming a continuous arch, and emitted radiant heat and light of the greatest intensity. The latter, indeed, proved highly injurious to the eyes of the spectators, in which, although they were protected by grey glasses of double thickness, a state of very active inflammation was induced. The arch of the flame between the electrodes was attracted or repelled by the poles of a magnet according as the one or the other pole was held above or below it; and the repulsion was at times so great as to extinguish the flame. When the flame was drawn from the pole of the magnet itself, included in the circuit, it rotated in a beautiful manner. The heating power of the battery was so great as to fuse, with the utmost readiness, a bar of platinum one eighth of an inch square; and the most influxible metals, such as pure rhodium, iridium, titanium, the native alloy of iridium and osmium, and the native alloy of platinum.

Lyell's "Elements of Geology"

ON June 1, 1839, in its column headed "Our Library Table", the *Athenæum* included this note about Lyell's "Elements". "The author states that the present treatise was originally intended to appear as a supplement to his 'Principles' but that he was subsequently induced to enlarge it, and bring it out in the form of a distinct work. It is an attempt—and we think a very successful one—to put forward in a simple and clear manner, those facts which are indispensable to a knowledge of the science, and to place the student in possession of the data by which geologists of the existing school explain the more palpable and widely spread geological phenomena. The bold and ingenious speculations, so ably developed by Mr. Lyell in his larger work, and to which his present fame is mainly to be attributed, are here, in a great measure, kept out of the field."

Societies and Academies

Paris

Academy of Sciences (*C.R.*, **208**, 1125–1176, April 12, 1939).

H. VALLÉE: The adjuvant factors of vaccination. The acidity of anthrax vaccine and its various insoluble sediments are essential factors in determining immunizing power.

O. C. DE BEAUREGARD: The problem of the exact measurement of a long line.

J. VILLEY and R. LEDUC: Auto-propulsion of a projectile-source.

L. MALAVARD: Prandtl's correction in a 'mixed' [partly directed, as opposed to free] channel: electrical method and calculation.

R. GRANDMONTAGNE: Evaluation of the brightness of the mean night sky by means of a cæsium photo-electric cell.

MLLE. P. FÉVRIER: Objective character of indiscernibility.

G. RIBAUD: Formulæ for the convection of heat for a fluid flowing normal to the axis of a cylinder.

MLLE. E. MONTEL: Determination of the mobilities of gaseous ions.

M. CHÊNE: Preparation of two phosphides of vanadium by fusion electrolysis [of vanadium anhydride dissolved in alkaline phosphates].

P. ROUARD: Study of very thin platinum films. The metal was deposited on glass by cathodic sputtering. Films less than 7 mμ in thickness are different in properties from the massive metal.

P. LAMBERT and J. LECOMTE: Infra-red absorption spectra of hydrocarbons of high molecular weight and of some heterocyclic compounds.

A. PIEKARA: Variation with heat of the magnetic birefringence of polar liquids.

MME. Z. SOUBAREW-CHÂTELAIN: Hydrated neutral sodium dimolybdate.

J. VAUTHRIN: Action of nitric acid on iron carbide.

MLLE. G. CAUQUIL: Action of selenium oxide on 1-methyl-4-isopropylidenecyclohexanone-3.

MLLE. Y. GARREAU: New addition products of diphenols.

B. BRAJNIKOV: Geology of Vérila Planina (Bulgaria).

E. DE MARTONNE: Formation of 'sugar-loaves' [rocky peaks with precipitous sides, several hundred metres high] in Brazil.

R. BERNARD: Possible presence of cyanogen bands in the spectra of the red auroras of type *B*.

MME. O. THELLIER: Diurnal variation of the electric conductance of the atmosphere and the number of ions and condensation nuclei at the Observatory of Chambon-la-Forêt.

MLLE. A.-M. DE LA BERNARDIE: Existence of antagonism between thyroxine and the vitamins.

B. S. LEVIN and L. OLITZKI: Total loss of pathogenic action of *B. typhi murium* given orally, after prolonged culture in lecithin media.

Budapest

Hungarian Academy of Sciences, April 17.

G. RADOS: Semi-definite Hermitian forms.

G. ZEMPLÉN: Synthesis of α-1-xylosido-6-glycose, the isomer and derivative of the primverose.

P. FRÖHLICH and I. MISCHUNG: Emission of phosphorus.

J. FINKEY: Flotation of grey slate from Recsk.

A. BUZÁGH and E. ERNYEI: Permeability and absorption of liquids by sediments.

F. PAPP: Several minerals from Szarvaskö.

G. ZILAHI SEBES: Sexual organs of the Heleides.

L. GOMBAY: Electric conductivity of phosphorus.

P. KOLLER: Development of the mechanism of sex determination.

Geneva

Physical and Natural History Society (Feb. 2, 1939).

E. PAREJAS: Transversal tectonic of Anatolia (preliminary note). The Alpine folding runs mainly from south-east to north-west. The most important transversals are those of the Dardanelles, Marmora-Antalya, Istanbul–Chypre, Tüz Gölü–Odessa, Kizil Irmak–Crimea, Kertch and the Caucasus.

MME. R. DOVAZ: Vaginal mucification in the pregnant guinea pig. During gestation, the ovaries sometimes contain big follicules; in such cases, there are excessive vaginal mucus and intense leucocytosis. The condition depends on the food conditions or the temperature.

A. MIRIMANOFF: Is sterilization in the cold possible in microbiology? Attempts to generalize the sterilization of culture media, at ordinary temperature, by volatile anæsthetics, which would conserve thermolabile factors, have been unsuccessful.

G. TIERCY: Solution of the equation of transfer of energy and the function $B(\tau)$ in astrophysics. Investigation of the form of $B(\tau)$ necessary to give a finite value at the surface of a star, and also to the intensity of radiation, while the derivative of the function would become infinite.

March 2, 1939.

E. BRINER and E. PERROTTET: Determination of the solubility of ozone in water.

T. POSTERNAK: Pigments of *Penicillium rubrum* and *P. citreoroseum*. The red pigment of the former is the phœnicine of *P. phœniceum* (2,2′-dioxy-4,4′-dimethyl-diquinone). The pigment of *P. citreoroseum* has the properties of a poly-oxyquinone.

J.-L. PERROT: Fertilization in *Arion empiricorum* Fer. (preliminary note). The possibility of direct self-fertilization by ripe autochtonous sperms in the ovo-testis cannot be excluded; but there seem to be varieties of different physiological character.

M. PERROT: Systematic position of *Euparypha pisana* Müller, from a study of the chromosomes. Conchological, anatomical and zoogeographical characters and cytological observations separate the genus *Euparypha* clearly from *Helix*, *Archelix* and *Cepæa*. It is proposed to put *Helix pisana* in a new sub-family, the Euparyphinæ.

E. A. H. FRIEDHEIM: Negative effect of sources of mitogenetic rays on growth of tissue cultures. Hanging-drop cultures of chick fibroblasts submitted to the action of various 'inductors' (root and juice of onion, cultures of *B. tumefaciens*, tadpoles and tadpole extract, chick embryo, embryo extract, normal and cancerous human blood, monochromatic ultra-violet light from 2,000 to 3,600 A.) have not shown more abundant mitoses than untreated cultures.

March 16.

P. BALAVOINE: (1) Variation of composition of the water of Lake Geneva. Analyses during 1936,

1937 and 1938 show that the surface water is impoverished in calcium carbonate during the warm months by 7–10 per cent in relation to the total dissolved matter. This seems to be a physico-chemical effect, rise of temperature playing the chief part in this precipitation. (2) Observations on snow. Snow is able to condense strongly traces of ammonia in the atmosphere. The ammonia content of snow is always very small (0·01–05 mgm. per litre of water of fusion, exceptionally 2·0 mgm. per litre); but this explains the presence of ammonia in tanks not receiving fæcal water.

M. GYSIN: A soda orthose in the syenitic rocks of Divrik (Turkey).

Moscow

Academy of Sciences (*C.R.*, **21**, No. 5; 1938).

N. GUNTHER: Theory of integrals of Stieltjes-Radon and integral equations.

K. WULFSON: Sensitivity threshold of a gas radiometer.

M. L. VEINGEROV: K. Wulfson's article "The Sensitivity Threshold of a Gas Radiometer".

R. I. GARBER: Formation of elastic twins during the twinning of calcite crystals.

N. MIHAL: Determination of gravity anomalies from the astronomical-geodetical deflection of a plumb-line.

V. I. NIKOLAEV and B. I. STEPANOV: A method for producing pure common salt through bihydrate of sodium chloride, $NaCl.2H_2O$.

V. I. NIKOLAEV and E. I. RUDENKO: Adsorptive properties of clay (kaolin).

G. B. BOKY: The number of physically simple crystal forms.

A. E. FERSMAN: Geochemistry of Kislovodsk environs.

A. K. GERGELEGIU: A new valuable bearer of vitamins and its commercial use.

D. S. BELIANKIN: Contribution to characteristics of the breccia-like and banded lavas of the volcano Elbrus.

G. L. KAMENSKI: Movement of ground waters in inter-riverine tracts.

E. N. SHMARGON: Analysis of the chromomere structure of mitotic chromosomes in rye.

P. A. POVOLOCHKO: Causes of constancy in the chromosome number of the autotetraploid *Nicotiana silvestris* var. *eghisii*.

V. L. RISCHKOV and K. S. SOUKHOV: Virus of the tobacco mosaic tested for its power of fermentative activity.

C.R., **21**, No. 6; 1938.

S. BACHVALOFF: Couples of stratifiable congruences.

N. DOBROTIN, N. IWANOWA and B. ISAJEV: Recoil-ray showers.

N. MALKIN: Helmert's formula and the isostasy hypothesis.

A. S. MOROZOV: Effect of sodium chloride and sodium sulphate salts on sugar content of melons.

S. W. BRUJEWICZ, R. M. PEVZNIAK, V. L. PONIZOVSKAJA and M. A. SIBIRJAKOV: Accumulation of biogenic elements (nutrient salts) in mud water of freshwater basins.

A. L. BEHNING: (1) Caspian relicts in the fauna of the Uzboi lakes. (2) Elements of subtropical fauna in rice fields of Uzbekistan.

T. K. ENIN: Intervarietal crossing in peas.

E. G. MININA: Phenotypical modification of sexual characters in higher plants under the influence of the conditions of nutrition and other external factors.

V. A. RYBIN: Colchicine-induced tetraploidy on flax.

SERGIUS LVOFF and G. M. TOUPIZINA: Effect of sodium fluorine on the formation of citric and gluconic acids of the fungus *Aspergillus niger*.

A. G. EBERZIN: The Azov horizon of Kuban.

Vienna

Academy of Sciences, February 2.

K. GRAFF: Variation of the brightness of the satellites Titan and Iapetus of Saturn during 1922. The author's measurements during 1922 are in agreement with the hypothesis that the eastern and western hemispheres of Iapetus have an albedo in the ratio 1 : 6·3. The same hypothesis is in agreement with the observations of Wendell from 1896 to 1900.

February 9.

W. JENTSCHKE and F. PRANKL: Confirmation of the formation of heavy nuclei by the disintegration of uranium bombarded by neutrons. The energy of the particles emitted by uranium under neutron bombardment is found, by measurement of the ionization they produce, to be not less than 6×10^7 ev, while their range is only about 2 cm.; they are, therefore, almost certainly heavy nuclei having a high charge.

L. SCHMID and W. HOSSE: Amber (5). The constituents soluble in alcohol are examined chemically.

F. KERNER v. MARILAUN: Temperature of springs on a slope of the Alps.

O. AMPFERER: Forms of mountain tectonics.

February 23.

L. SCHMID: Acids occurring in amber.

F. KOCZY: Determination of helium in rock-salt and sylvine. Rock-salt contains about 10^{-4} c.c. per gm. and sylvine about 10^{-5} c.c. per gm. of helium. The coloration of rock-salt is not connected systematically with the helium content; on the other hand, the magnitude of the latter indicates that the irradiation of the rock-salt must have been ample to produce the coloration.

G. ORTNER and G. PROTIWINSKY: Reaction of fast neutrons with neon nuclei. The neon was contained in an ionization chamber and the sum of the energies of the ^{17}O and ^4He nuclei into which it disintegrates on bombardment with neutrons was measured by the magnitude of the bursts of ionization produced. The results are in partial agreement with other work on the energy-levels of the ^{17}O nucleus when formed by other reactions.

W. CZULIUS and J. SCHINTLMEISTER: Method for separating the radioactive nuclei formed from uranium bombarded by neutrons. The nuclei arising from the explosion of the uranium nucleus are collected on a cylinder of celluloid wrapped around the uranium; by this means they are obtained free from any contamination by natural decay products of uranium.

K. W. F. KOHLRAUSCH and R. SABATHY: Studies of the Raman effect (99). Esters of mono- and poly-basic carboxylic acids.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :

LECTURER IN MECHANICAL ENGINEERING in the Heanor Mining and Technical School—Director of Education, County Education Office, Derby (May 27).

LECTURER IN PRODUCTION ENGINEERING in the Birmingham Central Technical College—The Chief Education Officer (May 31).

LECTURER IN MECHANICAL ENGINEERING in the Rugby College of Technology and Arts—The Principal, 61 Clifton Road, Rugby (May 31).

LECTURER IN ENGINEERING in the County Technical College, Wednesbury—The Director of Education, County Education Offices, Stafford (May 31).

TEACHER OF MATHEMATICS, PHYSICS AND CHEMISTRY in the Smethwick Technical College—The Chief Education Officer, Education Offices, 215 High Street, Smethwick (May 31).

LECTURER IN PHYSICS AND LECTURER IN TELECOMMUNICATION in the Woolwich Polytechnic, London, S.E.18—The Secretary (May 31).

LECTURER IN PHYSICS in the School of Science, Khartoum—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1 (May 31).

LECTURER IN THE DEPARTMENT OF PHYSICS AND APPLIED PHYSICS in the Technical College, Cardiff—The Director of Education, City Hall, Cardiff (June 2).

LECTURER IN ELECTRICAL ENGINEERING in King's College, Newcastle-upon-Tyne—The Registrar (June 3).

LECTURER IN ELECTRICAL ENGINEERING in the Shrewsbury Technical College—The Clerk to the Governors, County Buildings, Shrewsbury (June 3).

ASSISTANT LECTURER IN PHARMACOLOGY in the University of Sheffield—The Registrar (June 5).

LECTURERS IN CIVIL ENGINEERING, MATHEMATICS AND PHYSICS in the Northampton Polytechnic, St. John Street, E.C.1—The Principal (June 5).

HEAD OF THE DEPARTMENT OF ELECTRICAL ENGINEERING in the Northampton Polytechnic, St. John Street, E.C.1—The Principal (June 5).

CHEMISTS at the Royal Ordnance Factory, Irvine, Ayrshire—The Under-Secretary of State (C.5), The War Office, London, S.W.1 (June 5. Quote 141 *A*).

TECHNICAL ASSISTANTS (grade II—engineering) in the Munitions Technical Planning Establishment—The Under-Secretary of State (C5), The War Office, London, S.W. (June 6).

LECTURER IN PHYSICS AND MATHEMATICS and LECTURER IN MATHEMATICS AND ENGINEERING DRAWING in the Sir John Cass Technical Institute, Jewry Street, Aldgate, E.C.3—The Principal (June 7).

THREE ASSISTANTS (grade III—coal-mining explosives) at the Safety in Mines Research Board Station, Harpur Hill, Buxton—The Establishment Officer (June 10).

ASSISTANT LECTURER IN GEOGRAPHY in University College, Hull—The Registrar (June 10).

LECTURER IN CHEMISTRY and LECTURER IN MECHANICAL ENGINEERING in the Medway Technical College (Senior Department), Gillingham, Kent—The District Education Officer, Fort Pitt House, New Road, Rochester (June 10).

ASSISTANTS (grade III—metallurgy) in the Admiralty Technical Pool—The Secretary of the Admiralty (C.E. Branch. Ref. C.E. 5834/39. June 10).

ASSISTANT LECTURER IN GEOGRAPHY in the University of Sheffield—The Registrar (June 12).

ASSISTANT INSTRUCTOR IN AGRICULTURE in Nottinghamshire—The Director of Education, Shire Hall, Nottingham (June 14).

RESEARCH ASSISTANT IN VETERINARY PARASITOLOGY in King's College, Newcastle-upon-Tyne—The Secretary, Duke of Northumberland Memorial Fund (June 10).

RESEARCH OFFICER at the Farnham House Laboratory—The Secretary, Agricultural Research Council, 6A Dean's Yard, Westminster, S.W.1 (June 15).

UNIVERSITY LECTURER and TWO UNIVERSITY DEMONSTRATORS IN ANATOMY in the University of Cambridge—Dr. F. J. W. Roughton, Department of Physiology, Cambridge (June 17).

TWO SENIOR METEOROLOGICAL OFFICERS in Eire—The Secretary, Civil Service Commissioner, 45 Upper O'Connell Street, Dublin (June 20).

BIOCHEMIST at the Long Ashton Research Station—The Secretary, University of Bristol.

SENIOR LECTURER IN ELECTRICAL ENGINEERING in the County Technical College, Mansfield—The Principal.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Proceedings of the Royal Society of Edinburgh, Session 1938–1939. Vol. 59, Part 1, No. 5 : Solution in Multiple Series of a Type of Generalised Hypergeometric Equation. By Prof. T. M. MacRobert. Pp. 49–54. 6*d*. Vol. 59, Part 1, No. 6 : Investigation of Visual Threshold Values. By Mrs. E. M. Beattie. Pp. 55–61. 6*d*. Vol. 59, Part 1, No. 7 : The Fertility of Scottish Married Women, with Special Reference to the Period 1926–1935. By R. S. Barclay and Dr. W. O. Kermack. Pp. 62–80. 1*s*. 6*d*. (Edinburgh : Robert Grant and Son, Ltd. ; London : Williams and Norgate, Ltd.) [244

Annual Reports on the Progress of Chemistry for 1938. Vol. 35. Pp. xviii+447. (London : Chemical Society.) 13*s*. net. [244

Air Raid Shelters. Report of the Lord Privy Seal's Conference. (Cmd. 6006.) Pp. 26. (London : H.M. Stationery Office.) 6*d*. net. [244

Ministry of Health and Scottish Office. Inland Water Survey Committee : Third Annual Report, 1937–38. Pp. 23. (London : H.M. Stationery Office.) 4*d*. net. [244

International Committee for Bird Preservation : British Section. Annual Report for 1938. Pp. 35. (London : c/o Zoological Society of London.) [274

City of Norwich. Report of the Museums Committee to the City Council for the Years 1929–1938. Pp. 32+8 plates. (Norwich : Norwich Museum.) [284

Ministry of Health. Memo. Ev. 4 : Government Evacuation Scheme. Pp. 32. (London : H.M. Stationery Office.) 3*d*. net. [28

Other Countries

Smithsonian Institution. Explorations and Field-Work of the Smithsonian Institution in 1938. (Publication 3535.) Pp. iv+116. (Washington, D.C. : Smithsonian Institution.) [214

Field Museum of Natural History. Geological Series, Vol. 6, No. 23 : A New Amphicyon from the Deep River Miocene. By Paul O. McGrew. Pp. 341–350. 15 cents. Geological Series, Vol. 6, No. 24 : New Pantodonta and Dinocerata from the Upper Paleocene of Western Colorado. By Bryan Patterson. Pp. 351–384. 50 cents. (Chicago : Field Museum of Natural History.) [214

Kungl. Svenska Vetenskapsakademiens Handlingar. Series 3, Band 17, No. 1 : Botanische Ergebnisse der Schwedischen Expedition nach Patagonien und dem Feuerlande 1907–1909. 11 : Meeresalgen 3, Chlorophyceæ. Von D. E. Hyimö. Pp. 24. Serien 3, Band 17, No. 2 : Crinoids of S. Africa. By Torsten Gislén. Pp. 22+2 plates. Serien 3, Band 17, No. 3 : South African Actiniaria and Zoantharia. By Oskar Carlgren. Pp. 148+3 plates. (Stockholm : Almquist and Wiksell.) [214

Health Bulletin No. 12 (Malaria Bureau No. 4) : Table for the Identification of Indian Freshwater Fishes, with Descriptions of Certain Families and Observations on the Relative Utility of the Probable Larvivorous Fishes of India. Revised and enlarged by Dr. Sunder Lal Hora and the late Dev Dev Mukerji. Second edition. Pp. iii+47+7 plates. (Delhi : Manager of Publications.) 7 annas ; 8*d*. [244

Commonwealth of Australia : Council for Scientific and Industrial Research. Pamphlet No. 88 : The Oriental Peach Moth (*Cydia molesta* Busck). Investigations in the Goulburn Valley, Victoria ; Progress Report for the Seasons 1935–38. By G. A. H. Nelson. Pp. 23. Pamphlet No. 89 : Needle Fusion of *Pinus* in Southern New South Wales. By W. V. Ludbrook. Pp. 20. (Melbourne : Government Printer.) [244

Survey of India. General Report, 1938, from 1st October 1937 to 30th September 1938. Pp. xi+76+14 plates. (Calcutta : Survey of India.) 1.8 rupees ; 2*s*. 6*d*. [244

Kungl. Sjökarteverket. Ergebnisse der Beobachtungen des Magnetischen Observatoriums zu Lovö (Stockholm) im Jahre 1933. Pp. 101. Ergebnisse der Beobachtungen des Magnetischen Observatoriums zu Lovö (Stockholm) im Jahre 1934. Pp. 101. Jordmagnetiska Publikationer Nr. 12 : The Re-Survey of the Magnetic Main Repeat-Stations in Sweden for the Epoch July 1, 1936. By Gustaf S. Ljungdahl. Pp. 25. (Stockholm : Kungl. Sjökarteverket.) [244

Union of South Africa : Department of Mines. Geological Series, Bulletin No. 12 : The Gold Occurrences South-West of Pietersburg. By Dr. J. Willemse. Pp. 38+7 plates. (Pretoria : Government Printer.) 6*d*. [244

Government of Iraq : Ministry of Defence. Meteorological Service, Occasional Publication No. 1 : Mean Monthly Temperatures and Pressures at Three Selected Hours, Mean Monthly Maximum and Minimum Temperatures, Absolute Maximum and Minimum Temperatures and Mean Monthly Rainfall. Pp. 8. (Baghdad : Government Press.) 25 fils. [284

Advisory Committee on Education. Staff Study No. 4 : Federal Aid and the Tax Problem. By Clarence Heer. Pp. ix+101. (Washington, D.C. : Government Printing Office.) 15 cents. [274

U.S. Department of Agriculture. Circular No. 518 : Breeding Areas and Economic Distribution of the Beet Leafhopper in New Mexico, Southern Colorado, and Western Texas. By V. E. Romney. Pp. 15. (Washington, D.C. : Government Printing Office.) 5 cents. [274

Carnegie Endowment for International Peace. Annual Report for 1938 of the Division of Intercourse and Education. By Nicholas Murray Butler. Pp. 87+8 plates. (Washington, D.C., and New York : Carnegie Endowment for International Peace.) [284

Report of the Botanical Survey of India for 1937–38. Pp. 12. (Calcutta : Government of India Press.) [15

Catalogues, etc.

'Kodirex' : Kodak X-ray Film for use without Intensifying Screens. Pp. 4. (London : Kodak, Ltd.)

Zeiss Nachrichten. Folge 2, Heft 8, November 1938. Pp. 267–306. (Jena and London : Carl Zeiss.)

The Control of the Menopause. Pp. 20. (London : The British Drug Houses, Ltd.)

Länderkunde, Kartographie : Zeitschriften, Bücher, Abhandlungen. (Antiquariatskatalog Nr. 731.) Pp. 224. (Leipzig : Buchhandlung Gustav Fock, G.m.b.H.)

Aves, Mammalia, Pisces. (No. 97.) Pp. 52. (Den Haag : Antiquariaat Junk.)

South America, Central America and the West Indies : a Catalogue of Books, Prints, Old Maps. (Catalogue No. 638.) Pp. 70. A Catalogue of the Works of Novelists and Dramatists, General Literature, etc. (Catalogue No. 639.) Pp. 36. (London : Francis Edwards, Ltd.)